

Photon

Issue 1

February/March 2004

<http://www.nightskyobserver.com/Photon>



Starting Out in Astronomy

Observing the Moon

Darkness Over Africa

Build Your Own Observatory

Choosing a Telescope

Contents

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Editorial

Welcome to the first issue of **Photon**, a new bi-monthly astronomy magazine which aims to fill the gap left by the regular printed magazines.

The magazine is issued in PDF format and is currently only available for download from the internet. If there's enough requests, we'll consider providing it on CD as an alternative (for those with slow or no internet connection). The reason for it being a PDF is to keep the overheads on producing the magazine down.

Photon has been designed so that one page at a time fits on your monitor, so there's none of that messy scrolling up and down that's required in so many PDF documents. The Page Up and Page Down keyboard buttons will scroll up and down through the magazine one page at a time. Many of the articles have hotlinks embedded in them so you can jump straight to the relevant websites from within the magazine.

As you'll have noticed, this first issue is free. That's so it won't cost you anything to look it over and, hopefully, you'll find that we've hit on a niche that's not covered elsewhere.

Photon is written by amateurs for amateurs, focusing on topics that relate directly to amateur astronomy rather than the more esoteric, armchair-type subjects such as cosmology, the work of professional observatories or other non-practical related topics. Such topics are well served by mainstream magazines such as Sky & Telescope and Astronomy.

In our magazine you'll find subjects that have a more hands-on feel about them; experiences direct from one amateur to another. And we want this to be a magazine with an international flavor.

To that end, we're looking for submissions for the next and future issues, whatever part of the world you live in. The current issue should give you a flavor for the kind of articles we're looking for. Tell us about any astronomical trips you've been on, whether they're to local or national Star Parties or vacations based around an astronomical event such as a solar eclipse. Give us warts-and-all reviews of equipment you own, from a lowly pair of binoculars, to eyepieces to large expensive telescopes. Let us know what you think of recent books on astronomy or your appraisals of astronomy software, whether they're freeware, shareware or commercial applications.

We'd like a healthy dose of humor to appear in the magazine - there are enough po-faced approaches to our hobby out there as it is! So, let us have your astronomy jokes, stories and anecdotes or tell why astronomy can be a dangerous pursuit in your neck of the woods!

Why not profile your club or society - let us know what activities you get up to and what makes it special. If you recently formed a club, tell us what prompted you to do so and what goals you'd like it to achieve.

If you're a bit of a DIY or ATM enthusiast, tell us what equipment you've built or modified. Share any tips you think might be of use to other amateurs.

We're always on the lookout for astro-photos to use in the magazine, so please send us your images (and include as much info as possible on what equipment was used to take the photo, exposure times, etc.) Webcam and CCD astrophotography is now a huge interest area so if you use such equipment, let us know your experiences with it and the results you've achieved (good or bad).

While this first issue is free, we will be charging for subsequent issues. We have bills to pay, after all! However, the price is low, just \$3.00 per issue or a [year's subscription for \\$15.00](#). And we will be paying for any material used in future issues. How much depends on the response and take up of the magazine. The more people who subscribe, the bigger the payouts! So spread the word on **Photon** and start writing those articles! Copyright of all material will still reside with submitting authors.

What you won't find in the magazine is a sky diary. These are plentiful enough through mainstream publications and there's a plethora of them on the internet, many devoted to your particular part of the planet. We are interested in subjects of observation, things you've done yourself, whether it be a description of the first time you saw the moon through a telescope or the kick you got out of doing a messier marathon.

If you're submitting large astrophotos for consideration, we'll scale them down to fit in the magazine (and save space) but if you want to provide us with a web address for the original full-size image, we'll include those with any photos used.

Also, tell us a little about yourself (include a picture, if you like) so our readers can get to know you a little bit.

We're also on the lookout for advertisers. If you would like to advertise (or know anyone who does) please contact the editor at the address below for rates.

Thanks for downloading and reading the magazine and let us know what you think of this first issue. We hope it's the start of something grand!

Gary Nugent
photonmag@excite.com

Starting Out in Astronomy

Fintan Sheerin

Dressing properly for an observing session is vital if you want to stay warm and enjoy the experience. This article tells you how to do just that.

First Mistakes

Most people, at some time in their lives, look up at the night sky. Some are awe-struck, others mildly interested, and still others are not even aware that they have looked up in the first place, and consequently go about their lives oblivious to the 99.99% of the universe which is not Earth-based! Those who are filled with wonder usually develop their interest fully, and join an astronomical society, while those with a mild interest may venture out again, perhaps to a Star Party. What happens? They arrive in suits and dresses - the most inappropriate clothing - freeze, and then decide that astronomy is not for them. It cannot be emphasised enough that one must be adequately prepared for observing. Clothing is all-important, and as seen in fig. 1, incorporates several layers of loose-fitting and warm items. You may vary in the make-up of your protective clothing, but ensure that you are warm. Always wear a hat as it is estimated that up to 60% of body heat is lost through the head.

What to Take With You

It is normal to take breaks during an observing session in order to warm up and to rest the eyes. After 30 minutes or so, in -2C, a cup of hot soup, coffee or cocoa is very welcome, and only involves a few minutes of preparation before setting out. So, bring a flask. If you

are going out on a general naked-eye or meteor observing session, bring a plastic groundsheet to lie on, or a reclining deck-chair (if you can carry it). These reduce the risk of neck strain due to cold muscles, and prolonged neck flexion if standing.

On the astronomy side, a star map is a must. This can take the form of a single sheet (such as the Philip's Chart of the Stars), or a multi-chart format, as in Norton's Star Atlas. A planisphere can also be useful in helping the beginner to locate individual constellations and stars. This, and the star maps, may be obtained from good bookshops. Bring a red torch, such as a bicycle back light, for reading maps and charts. Red light places less strain on the eyes than white, and so causes little disruption to dark adapted eyes. A clipboard with blank, white paper, and a HB pencil, should be brought for recording details of objects seen, and drawings of meteors, etc. These can be transferred into a formal observing log later on, after the watch.

What To Look For

Many of the nights spent observing will merely involve you in becoming familiar with the night sky. This must be the first step on the road towards proficiency in astronomical observing, as it is only by becoming familiar with the "unchanging sky" that one can begin to notice those objects which move. Learning constellation names and stars takes many hours of practice and observing. A series of articles on constellations, has been featured in this and prior issues of Orbit, and

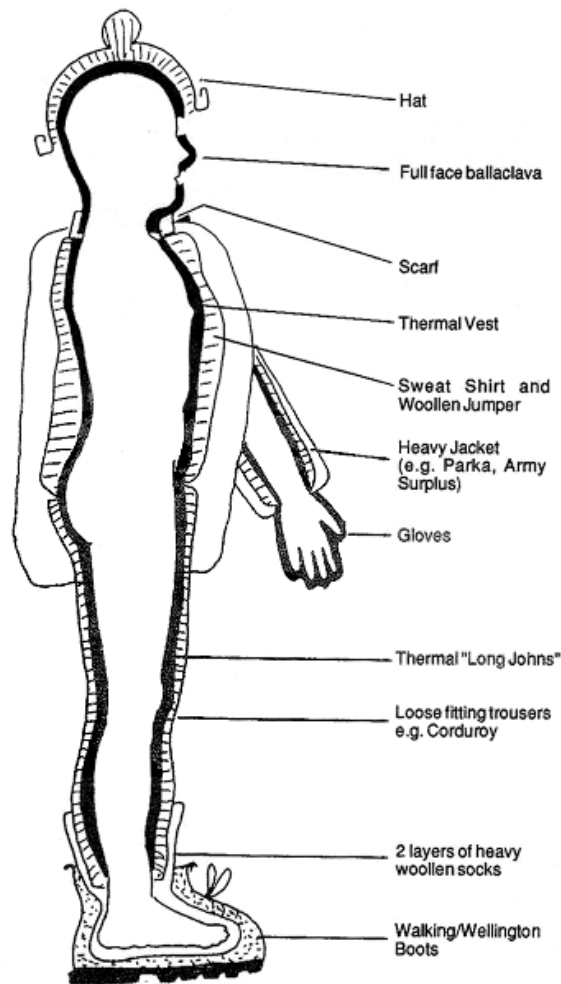


Fig.1: The well-dressed astronomer

these will form a basis on which inexperienced astronomers can develop that required learning. In the mean-

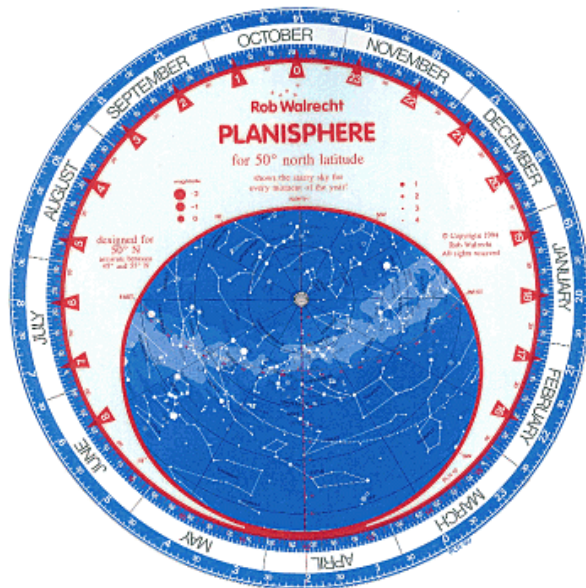


Fig.2: Learn your way around the sky with a Planisphere

time though, identify the most famous constellations such as the Plough (Ursa Major), Orion and Cassiopeia. As you observe, you will notice several interesting differences between particular stars: First, some are brighter than others. This relative brightness of stars (and other celestial objects) is called Magnitude, and is dependant on the luminosity of the star and its distance from Earth. It should be noted that, on the magnitude scale, the brighter the star, the lower its assigned magnitude (hence - 1 is brighter than +1).

Second, you will see some stars that appear to be made up of two components. These are double stars, and may involve a pair of stars revolving about a common centre of gravity under the influence of their mutual gravitational attraction (a Binary star), or two stars

which appear close together because they lie nearly in the same direction from Earth, but are in fact many light years apart (an Optical double star). Look at the second star in the "handle" of the Plough and you will see the optical double, Mizar and Alcor.

Thirdly, you may notice that not all stars are the same colour. For example, Betelgeuse, at the top left corner of Orion, appears vividly red when contrasted with Rigel, at the bottom right corner, which seems bluish-white. This is due to the fact that these stars belong to different spectral types, and so possess different characteristics.

Scattered throughout the sky are closely-knit groups of stars, called star clusters. These may be wide open, as with the Hyades, or closer as with the Pleiades, both of which are in Taurus. Other groups of stars take on what appears to be a much, much tighter grouping. This may be due to the vast distance between them and us, perhaps placing them outside our own galaxy. These are themselves galaxies, and one naked-eye example is the Andromeda Galaxy, which is estimated to be some 2.2 million light years away, and appears as a faint "fuzzy star". Our own galaxy - the Milky Way - is more observable, stretching across the sky as a wide band of luminosity. Mention should also be made of nebulae. These clouds of interstellar dust, often associated with stellar development, are difficult to see with the unaided eye, though one - the Great Nebula in Orion, may be observed as a luminous patch in the centre of Orion's Sword. A useful method for observing faint objects is the Averted Vision technique. All that is involved to locate an object, is to look at it and then avert your eyes slightly away from it. Often the object will be noticed "through the corner of your eye", so to speak.

All of the above objects are unchanging in the night sky. Other starlike bodies will be noticed, in the sky, though, which are not on the star charts and which appear to change their positions nightly. These are the planets, and six are visible to the naked-eye - Mercury, Venus, Mars, Jupiter, Saturn and sometimes Uranus.

The planets are different to stars in several ways. A star may be defined as a luminous, gaseous body, that generates energy by means of nuclear fusion reactions in its core. A planet on the other hand, is a body which orbits the Sun or another star and shines by reflected light. To the naked-eye observer, the main interest in planets lies in tracing their paths across the sky, and noting how some tend to backtrack as the months pass by.

The Moon displays little to those without optical aid, but does go through a monthly cycle of phases. An interesting exercise is to judge the positions of the Earth and Moon with respect to the Sun during each phase. Look out also for occultations - that is when the Moon passes over a star or planet. Predictions for these are listed in the Skynotes.

Very occasionally, a bright comet may grace our skies. This may appear either as a "fuzzy star" or as a classic comet, with a prominent head and streaming tail. More often though, the only sight of cometary matter which we can see every night, is observed to whizz across the sky in less than a second. These starlike objects are, of course, meteors or shooting stars, and are usually caused when the Earth passes through dust spread out along the orbit of a comet. Rates during these meteor showers may rise to as many as 100 per hour. Full details of current meteor showers are given in the Skynotes. Often, new observers mistake slow-moving objects which cross the sky in a matter of minutes, for

meteors. These are in fact, manmade artificial satellites in Earth orbit. One of the most interesting of these at present, is the International Space Station, which is regularly seen over Ireland.

Is Light Pollution A Problem?

Frankly, yes. But this does not rule out observing in urban areas. Light pollution, while reducing the number and quality of observable objects, does not block out all stars or planets. A colleague once suggested the use of a cardboard box, placed over the head and resting



Fig.3: a thermal flask - essential equipment for a Star Party!

on the shoulders, as a method for dealing with troublesome light. This blinkers the lateral views of the observer, and I can vouch for its effectiveness. You may think that you will look ridiculous with such a contraption on your head, but let's face it, people generally consider astronomers to be weird anyway!

Conclusion

The most significant way of getting started in astronomy, whether young or old, is to join an astronomical association. There, you will find other ordinary people who have been amateur astronomers for many years, and who will be more than pleased to advise and help you on the road to becoming proficient in the science of amateur astronomy.

Crash Test Chickens

Scientists at NASA had built a gun specifically to launch dead chickens at the windshields of airliners, military jets and the space shuttle, all travelling at maximum velocity. The idea was to simulate the frequent incidents of collisions with airborne fowl to test the strength of the windshields.

British engineers heard about the gun and were eager to test it on the windshields of their new high-speed trains. Arrangements were made, and a gun was sent to the British engineers.

When the gun was fired and the chicken hurtled out of the barrel, the engineers stood shocked as it crashed into the shatterproof windshield, smashed it to smithereens; blasted through the control console, snapped the engineer's backrest in two and embedded itself in the back wall of the cabin.

The Britons sent NASA a detailed report covering the exact steps they had followed and the disastrous results of the experiment, along with the design of the windshield, and asked the U.S. scientists for suggestions.

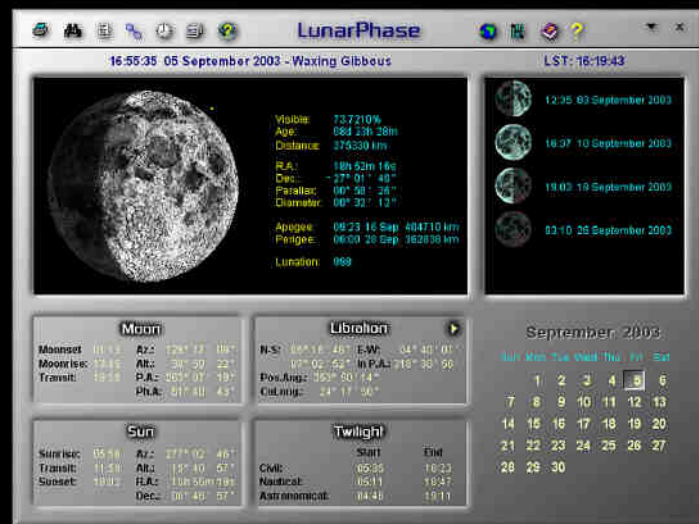
NASA responded with a three-word memo: 'Thaw the chicken.'

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Book Review

By Tim Carr

Ingenious Pursuits by Lisa Jardine

ISBN: 0385720017

Did you know that Sir Christopher Wren was a professor of astronomy? Strictly speaking, designing St. Paul's Cathedral was an extra-curricular activity. Did you know that Edmund Halley's greatest contribution to astronomy was not his predicting the return of the comet bearing his name? He was the one who persuaded Newton to publish his momentous discoveries concerning gravity and optics. Did you know that Christian Huygens' discovery of Titan and understanding of what exactly Saturn's rings were, are almost modest compared to his construction of the first really accurate clock? Modern science depends on it!

Well maybe you did, but I didn't; at least not until I read Lisa Jardine's very detailed but eminently readable book about the scientific discoveries of the 17th and 18th centuries and the people who made them. In her introduction, Jardine makes the case for scientists to be viewed with more sympathy and less suspicion. We have unprecedented access to information allowing us to educate ourselves as never before. Yet many of the populace view science with a suspicion based on ignorance. Ignorance not only of even the most basic facts of science but also of the huge importance it plays in our lives. This is one of a number of books that try to popularise science by telling its history as a story; a story full of drama, human failings and heroics, petulant patriotism and patronage. In other words, it says that far from scientists being the soulless automatons of popular ignorance they are all too human, both in their failings and their greatness.

The book starts with the story of why the Royal Observatory in Greenwich was built (in order to help establish longitude at sea) and also who built it and how. Sir Jonas Moore was the driving force behind both funding and construction. Wren and Hooke designed it and Moore installed John Flamsteed as the first Astronomer Royal. Great...except Moore discovered that Flamsteed was an observer who took devotion to duty to ludicrous extremes. Although his measurements were more than enough to satisfy the most demanding sailor in locating his position, the new Astronomer Royal stubbornly refused to publish his observations until he was happy with them. Not only did Moore die without ever seeing these observations in print, Flamsteed did too. Quite remarkable when you realise that he started his observing in 1675 and kept them up until his death in 1719!

The story moves on to one of the main characters of the book — Robert Hooke. On the debit side, he emerges as the type of guy that would argue with Christ up on the cross (he had a long running dispute with Huygens regarding the invention of the balance wheel in clocks).

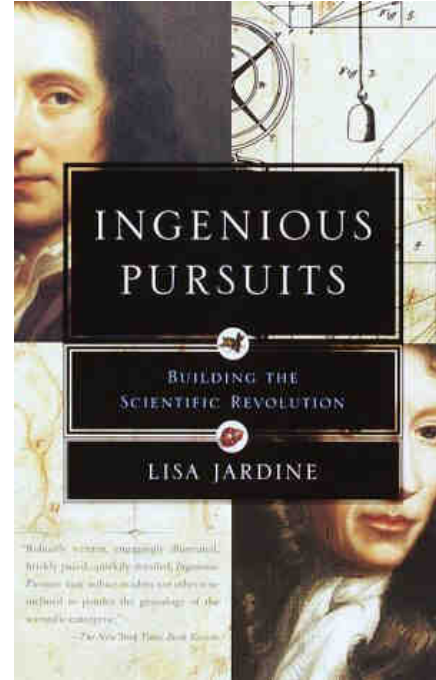
On the credit side, however, we learn that not only was he involved with Wren in designing St. Paul's but he was the designer and maker of the most superb scientific instruments. A pioneer in the development of compound microscopes, even he could not match the work

of another of scientific history's (and therefore history's) great figures — Anthony Von Leeuwenhoek. This Dutch civil servant never used anything other than a simple microscope but made and used them to such an exceptional standard that not only did he discover bacteria but it was another hundred years before anyone else managed to see them!

Jardine eventually moves into the territory of botany, concentrating on the medical and huge commercial implications of expeditions to far-flung places. I was less interested in these chapters but only because I am not that interested in plants. Nevertheless, I felt they took up too much of the book (which, by the way, is well illustrated both in colour and black-and-white).

Eventually the author leaves botany behind and tells the story of Henry Oldenburg who set up voluminous correspondence between various scientists and contributed to the dissemination of information around Europe. The last chapter deals with Crick and

Watson's historic discovery of the structure of the DNA molecule, giving due credit to the now (largely forgotten) Rosalind Franklin, whose excellent X-Ray diffraction photos led her to suspect what Crick and Watson used those same images to prove. Franklin died tragically young and surprisingly is omitted from the very useful thumbnail descriptions of the work of the main characters.



Urban Observing

By Kevin Berwick

Most amateur astronomers live in urban or suburban settings. The purpose of this article is to discuss the problems associated with observational astronomy for observers living in these areas and to suggest some simple techniques which can be applied to maximise enjoyment of the hobby.

Light pollution

All the objects we observe in amateur astronomy are either small or dim or both!! Artificial lighting escaping from poorly designed fixtures lights up the night sky. This reduces the visibility of faint objects in particular, greatly reducing the detail that can be seen in clusters and nebulae in particular.

Streetlights, security lights and light escaping from buildings all contribute to light pollution. There are two types of streetlights in common use - Low Pressure Sodium (LPS) and High Pressure Sodium (HPS). LPS lights are orange in colour and very energy efficient. The large fixture on these lights means full cutoff fixtures, those which prevent any light from escaping upwards into the sky, are rare.

HPS lights are pink in colour and much more wasteful of energy than the LPS alternative. The small light does allow the use of full cutoff fixtures, however, at present, in many locations, these fixtures are not fitted to lights.

If full cutoff fixtures aren't used, 20-30% of light gets

reflected upwards to the night sky where it is wasted. Full cutoff fixtures are also more energy efficient, directing the light downwards where it is required. Light trespass, unwanted light spill on to your property, is reduced.

Private lighting is a new threat to the night sky, in particular poorly installed security lights. The addition of a motion sensor to the light offers at least a partial remedy. It may be worth approaching the neighbours or shops in question to ask them to fit these if this is a problem at your observing site.

The International Dark Sky Association

The [International Dark Sky Association](#) is a non-profit organisation which offers advice on combating light pollution. If you decide to take up this issue with your local authority, it is a good source of information and ammunition.

Target Objects for the Urban Observer

The Sun is unaffected by light pollution and can easily be observed in white light with objective filters or by projection of the image on to a piece of white card. You need to be very careful when doing either however, since a mistake could cost you your eyesight. **BE CAREFUL!!**

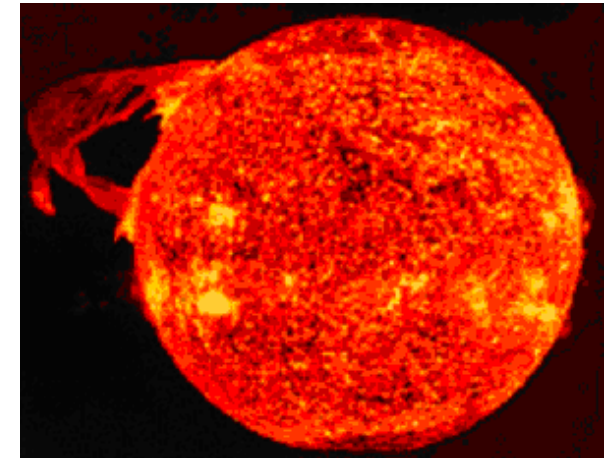
H alpha observing of the Sun is fascinating, allowing you to see prominences, large loops of glowing gas, and other features on the solar disk. Unfortunately,

even entry level systems cost a few thousand Dollars or Euros so it is expensive.

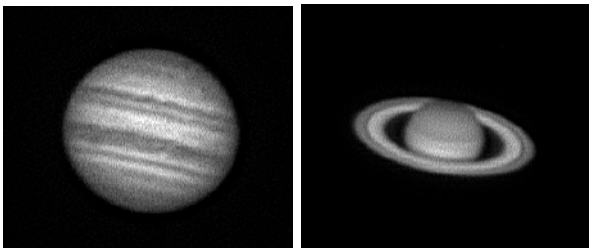
It is well worth developing an interest in solar observing as it doubles the potential time available to you to pursue your hobby.

The Moon is as impressive from the city as it is from Hawaii, with craters, mountains and rilles all visible at the terminator with even modest instruments. The moon is a great interest when the deep sky is unavailable, even to rural dwellers. Occultations, when the moon covers a star or planet, can also be fascinating and potentially scientifically useful. Also, 'seeing', the steadiness of the air, can be very good in cities, one of the few advantages of urban dwelling.

The planets are also an ideal urban target. Jupiter is an amazing view through even a 4-inch telescope for a large part of the year. The planet shows lots of features, belts, spots and ovals. The planet's appearance



The sun in hydrogen alpha



CCD images of Jupiter and Saturn; Photos: Gary Nugent

is also very dynamic, changing rapidly from night to night. In addition, a variety of phenomena involving the moons of Jupiter such as shadow transits across the globe and occultations are also visible nightly.

Mars is a fabulous target every two years during opposition when it comes close to the Earth. At this time, the polar cap, dark markings and clouds are visible on the disc through even a 60mm refractor.

Saturn's rings are always a treat and subtle detail can be glimpsed on the globe, although the disc is never as spectacular as that of Jupiter.

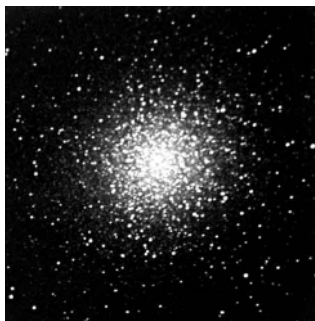
The phases of Venus can also be seen using even a small telescope. Asteroids can also be easily spotted from the city, provided they are reasonably bright. Comets are visible only if bright though they do provide a good target for CCD photography. Finally, man made objects such as artificial satellites and Iridium flares can be observed with the naked eye by following predictions at the heavens-above website.

The Deep Sky

You can be a deep sky observer in the city! The easiest and best introduction to the deep sky is via the Messier objects, a compilation of the best that the Northern hemisphere has to offer the deep sky observer.

Observing variable stars and double stars is a gentle introduction to the deep sky. The brightness variations of variable stars can be followed even with binoculars. Double stars can be an excellent test for your optics. Also, since they often consist of stars with different colours, the colour contrast can be very beautiful.

Globular and open clusters are a great urban target, since they bear magnification well, and high magnification darkens the sky background. Planetary nebulae need high magnification, respond well to OIII filters



Deep Sky Object: Globular Cluster M13 in Hercules

and are also a great urban target. Emission nebulae such as the Orion nebula, M42, benefit greatly from LPR filters. Reflection nebulae, like M78 or the nebulosity around the Pleiades, are unaffected by LPR filters so if you want to see these, it may be worth waiting until you take a trip to the countryside.

The Urbanscope

Remember that the best telescope is the one that gets used most. It may be worth considering 7x50 Binoculars for quick looks when the hassle of getting out your main scope is too much. When it comes to choosing a telescope, a short setup time means the scope gets used more so it is worth having a small telescope in the city, particularly if you want to travel to escape light pollution. Alt-azimuth mounts are much faster to setup than equatorials so you might want to bear this in mind also.



The Orion Short tube 80, a good portable urbanscope

at the expense of aperture. The long f-ratio will ensure that the central obstruction is low while the quality optics will boost contrast.

Regardless of the type of optical system, try and maximise the Signal/Noise ratio by keeping the optics clean and either choosing a well baffled scope or adding baffles to your existing scope.

The Time And The Place

The best time to observe is when there is no moon, since the moon reduces contrast. The later you observe the better. If you observe after 10:00pm this gives dust and water in the air time to settle. If you observe after 11:00pm, most shops will have turned off their lights and skyglow is reduced considerably. If you observe after 1:00am, there is a lot less traffic on the streets, and light pollution is reduced.

Ask your neighbours over for an observing session. After seeing the effect of light pollution on observing, they may be more co-operative in turning off their lights for you.



If this is your back garden, you shouldn't be reading this article!!Photo: Kevin Berwick

Obviously, pick the darkest section of your site. If there are lights flooding into your site, attempt to block out stray light using existing structures and foliage to block the direct view of lights.

Tips

Always try to catch your target objects straight overhead. This is always the darkest part of the sky. Magnitude is not everything. A bright galaxy may be invisible, whereas a dim planetary may be easily seen. Small, high surface brightness and stellar objects are easier to observe than large, diffuse objects. Use a dark cloth to cover your head and eyepiece to shield them from stray light. Use a dew shield on your telescope to shade it from stray light. Clean and collimate all optics since dirty optics scatter light. One good tip if light pollution is severe is to use high magnification to darken the background.

The Lumicon OIII filter

Light pollution and O-III filters are good for planetary and emission nebulae, greatly boosting contrast. Digital

Setting circles are a great aid for finding difficult objects. Often, for difficult objects, it is great just to be sure that the 'smudge' you are seeking is in the field and that you haven't got lost during your starhop. Cool, dry nights are best at any location, but are more pronounced in the city. Before you start observing, read the quality of the sky by observing stars with the naked eye. If faint stars are visible try for faint fuzzies. If seeing is good take a look at the Moon or planets. It is often a good time to observe after rain. The skies appear darker as light is no longer reflected off airborne dust. In addition, the sky is often clearer after a cold front has come through. The air is more stable since air pollution is blown out.

Most importantly, **ATTITUDE** is very important. **ANY** observing is better than no observing or TV.

Accessories

As I mentioned before, GOTO or Digital Setting Circles are invaluable in the City. Light pollution often means that there simply aren't enough guide stars available to starhop to your target. Also knowing that the object you are seeking is in the field encourages you to persevere with fainter targets.

Nebular Filters :- OIII, H Beta, UHC LPR filters from Lumicon are an excellent aid to the city observer, boosting contrast greatly. Often, these filters will render previously invisible objects visible. They operate best with scopes that have apertures greater than 4 inches.



The Lumicon OIII filter

If you are interested in astrophotography from the city, CCD cameras are best since the routine of 'background subtraction' removes orange sky from your pictures!! This is not possible with film.

Travel

As little as half an hour in the car can transform the sky, so it is well worth travelling.

It is worth having an easily portable telescope just for this purpose. Consider keeping a small, cheap scope in the car boot for quick looks when travelling around. Always bring Binoculars/Travelscope on your summer holidays, to take advantage of any observing opportunities in the darker location.



The ETX - a typical GOTO telescope

It may be worth considering a trip to **Centro de Observação Astronómica no Algarve** ([COAA](#)) in Portugal or its equivalent in US. These places offer dark skies and scopes for rental. Two weeks holiday in Arizona and you could get more observing done than in a year in some inclement area of the world!

Finally, when travelling to dark skies always look up the local Astronomy Club on the Internet. Often, they are very happy to take out fellow astronomers and show them the sights from their country.

Final thoughts

- There is a good selection of targets are unaffected by light pollution.
- Make observing easy, choose telescope and location carefully.
- Use technology, filters, computerised mounts
- Consider travel, it's a part of many hobbies such as golf and fishing, Why not astronomy?
- Attitude is crucial

Resources (Books)

From City lights to Deep Space, Rod Mollise, available FREE to download from the Mobile Astronomy Society:

<http://hometown.aol.com/RMOLLISE/index.html>

Observers Handook, Astronomy from towns and suburbs, Robin Scagell, Philips, 1994.

Resources (Web)

<http://skyandtelescope.com> - Sky & Telescope Online

<http://www.cloudynights.com> - Online Reviews

<http://www.heavens-above.com> Iridium flare info

<http://www.lumicon.com> - Lumicon Products

<http://www.darksky.org/ida/index.html> - International Dark Sky Association

<http://www.ip.pt/coaa/> - Centro de Observação Astronómica no Algarve

<http://www.starhillinn.com/StarHillInn.html> - Star Hill Inn

<http://www.jacknewton.com/> - Newton Observatory Bed & Breakfast and Arizona Sky Village

<http://www.corvus.com> - American Association of Amateur Astronomers

<http://www.astroleague.org/> - Astronomical League

news:sci.astro.amateur or

<http://groups.google.com/groups?q=sci.astro.amateur>

- sci.astro.amateur newsgroup on USENET

Astronomy Students Say the Strangest Things!

These are genuine, unexpurgated snippets from introductory astronomy classes at the University of Alabama.

Some 200 years ago, X-ray astronomy was used to obtain temperatures of the atmosphere at many different altitudes.

This era has experienced a new aspect of science termed Radio Astronomy, "a vile new science which stemmed from radio engineering but finally became established as a powerful complementary ally to the most ancient of the sciences".

There is a bright side to being the first and only intelligent beings in our galaxy - we will have the chance to found the Galactic Empire!

The incredible fascination with the Milky Way has become so great that poets have even written poems about it. Most of this reasoning lies in the fact that the Milky Way is not alone. It is part of the magnificent Milky Way Galaxy which is still being studied today.

Since the distance from the centre of the earth to its outer edge is 4000 times farther than from the

earth to the moon, the gravitational pull from the moon pulls the liquid part of our earth to a slight point.

Radio telescopes can become blurred because of the actual radio waves in motion.

A radio telescope often sends messages to the astronomer by the use of frequencies.

The Sun is one of the clearest stars to be seen on earth because it has the largest animosity.

When the possibility of life existing in other places is discussed, the planet Jupiter is left out.

In that experiment results support the theory that life once may have been present on Earth years ago.

A main sequence star transforms into a Red Giant - the Red Giant is very hot. The Red Giant goes to the envelope magnitude and after gradual cooling, the end process is a white dwarf. A white dwarf generates no energy inside its core. This whole process can take months and sometimes years.

These smaller planets are said to be fragments produced by collisions and some of the larger ones were named by the collisions.

Observing the Moon

by Gary Nugent

Introduction

Selene, Luna, Mistress of the Dark - the moon has many names. Forged in fire and catastrophe, been Earth's faithful companion for billions of years. the only world on which we can see topography and the only world mankind has visited in person. But its commonplace appearance in our skies belies its fascinating history and its observational pleasures.

Observe the moon over a few nights and you'll soon notice a couple things about it. It doesn't rise and set at roughly the same time of day (as does the Sun) and the bright portion of its disk changes slightly from night to night, sometimes the bright fraction decreases and sometimes it increases. Other observations you might make are that the moon looks bigger on the horizon than when overhead; you can see large dark and bright areas on its surface and smaller features as well; you can sometimes see it during the day and occasionally, it turns a coppery brown colour. So what's going on?

The Moon's Face

Do you remember when you were a kid, your dad (most likely – but not being sexist here) pointed out the man in the moon to you? Well, if you don't, or he

didn't, too bad. I always thought the man in the moon had been in one fight too many by the looks of him - a somewhat sinister disfigured visage.

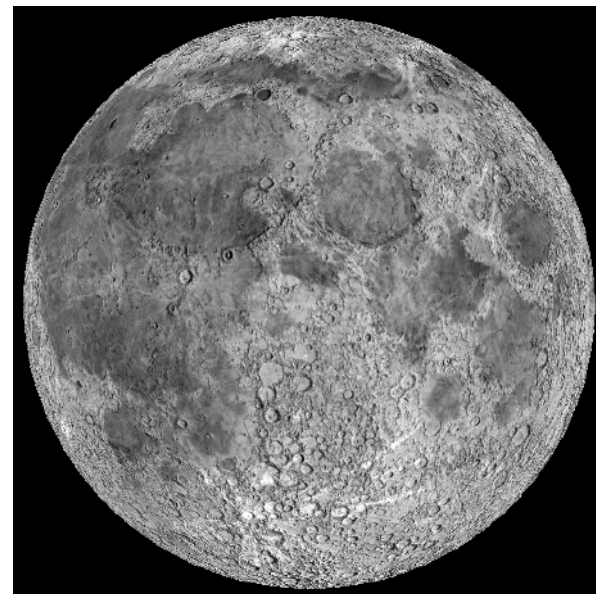
How and ever, the man in the moon's facial features are composed of a variety of actual physical lunar landscapes. Contrary to a once-popular cultural myth, the moon is made of rock and not green cheese (surprisingly – or perhaps not! – 12% of Americans believe at least part of the Moon is made of cheese!). The surface of the moon contains a multitude of craters, splash marks, lava outflows, walls and mountains ranging in colour from dark grey to white. These features are changeless as the moon has no atmosphere to cause the erosion that Earth's atmosphere does down here. The features you see on the moon every night have essentially been that way for a billion years. Occasionally, though, a meteor will strike the moon, creating a new crater and altering the local landscape with a splash of lunar dust and pulverised rock. Such events, though, are exceedingly rare.

Why the Moon Always Looks the Same

Further observation of the moon will show that it always keeps the same face to us. No matter what night you go out to look at the moon, it always looks the

same apart from its phase. Why is this?

It all comes down to what are called "tidal forces". Everyone knows that the moon causes the tides in our oceans, but what is less-well known but equally real is that there is a tidal distortion of our entire planet. The continents and everything underneath (such as magma, the molten material on which the continents float) are deformed on a daily basis by the tidal forces of the sun and moon. Surprisingly, tides are raised in the continents as well as the oceans, although not to the same extent (and you never noticed!). The closer a moon or satellite to its planet, the greater the tidal force on both bodies. But I haven't really explained what a tidal force is. It all has to do with gravity. Gravity is an inherent property of matter. Everything from the smallest atom



Full Moon - where mythological features can be seen!

to entire galaxies possess it. The more mass a body has (i.e. the more stuff that's in it), the greater its gravity. That's why leaping with abandon on an asteroid is not such a good idea - their gravity is too low to stop you sailing away into space. not such a good idea down here either as you'll come crashing to the ground and look like a complete prat. The moon, being smaller than the Earth, has less gravity and you too could be superman (or woman) on such a world, leaping tall(ish) buildings in a single bound.

A digression on the Nature of Tides

But gravity is a funny thing. It obeys what's called the inverse square law. All that means is that the closer you are to a large body (like a planet), the stronger you feel its "pull". That's why you accelerate when you fall - on Earth, air resistance eventually stops your acceleration once you reach a certain velocity but on the moon and other airless bodies, you would continue to accelerate until you finally hit the ground. (As they say, not the fall that kills you but the sudden stop at the end!)

Now, here's the weird bit: Another consequence is that gravity doesn't act on a body as a whole, but differentially on each atom in it. So the near side of the moon is attracted more strongly by the Earth than the far side. Likewise, the side of Earth facing the moon is attracted by the moon more strongly than the Earth's opposite side. The net effect is that the bodies are stretched slightly. You can think of it this way: think of a beach ball and imagine that you glue it to the ground (using a super glue that actually works). You then attach a really powerful suction cup (with associated handle) to the ball at the point where it's exactly on the opposite side of the ball to the point where the ball is glued to the ground. You then impersonate the moon by pulling on the suction cup handle. Assuming the

Has Anyone Ever Seen a Meteor Strike the Moon? - Part I

Well, possibly, is the answer. About an hour after sunset on June 18, 1178 A.D., a group of five eyewitnesses watched as the upper horn of the bright, new crescent Moon "suddenly split in two. From the mid-point of this division a flaming torch sprang up, spewing out...fire, hot coals and sparks... The body of the moon, which was below writhed...throbbed like a wounded snake." The phenomenon recurred another dozen times or more, the witnesses reported.

The dramatic passage in question appears in the medieval chronicles of Gervase of Canterbury.

What was it they saw? A geologist suggested in 1976 that this account is consistent with the location and age of the 22-kilometre (14-mile) lunar crater Giordano Bruno, the youngest crater of its size or larger on the Moon. But this idea doesn't hold up under scientific scrutiny.

Such an impact would have triggered a blizzard-like, week-long meteor storm on Earth - yet there are no accounts of such a storm in any known historical record, including the European, Chinese, Arabic, Japanese and Korean astronomical archives.

Based on the size of the crater, it must have been a one-to-three kilometre wide (a half-mile to almost 2-mile wide) asteroid that blasted Giordano Bruno

into the Moon's northeast limb. Such an impact on the Earth would be "civilization threatening".

The impact would have launched 10 million tons of ejecta into the Earth's atmosphere in the following week, previous studies have shown. This would have caused a week-long meteor storm comparable to the peak of the 1966 Leonids. Ten million tons of rock showering the entire Earth as pieces of ejecta about a centimetre across (inch-sized fragments) for a week is equivalent to 50,000 meteors each hour. They would also have been very bright, and very easy to see at magnitude 1 or magnitude 2.

Yet no vigilant 12th century sky watcher reported such a storm. So what did the witnesses see that the Canterbury monk recorded?

What's likely to have happened is that they were in the right place at the right time to look up in the sky and see a meteor that was directly in front of the moon, coming straight towards them. This idea was strongly suggested by scientists in a 1977 scientific paper.

And it was a pretty spectacular meteor that burst into flames in the Earth's atmosphere - fizzling, bubbling, and spluttering. If you were in the right 1-2 km patch on Earth's surface, you would get the perfect geometry to see the event. That would explain why only five people are recorded to have seen it.

glue holds and you haven't thrown the Earth (the ball) out of the solar system, the ball should contort slightly so that now shaped more like a rugby ball than a soccer ball. Congratulations, despite the arrival of the men

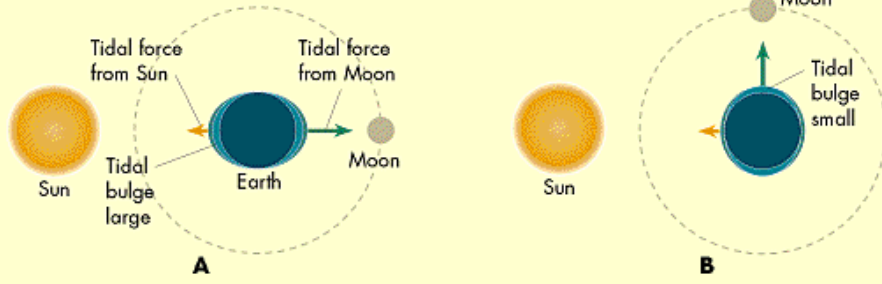
in white coats (whom your neighbours so obligingly called), you've demonstrated a simple example of tidal forces.



High Tide



Low Tide



How the moon affects the tides

While this example isn't strictly correct, it serves to illustrate what gravity is doing. The key thing with tides on a spherical body such as the moon or Earth, is to think of a rugby ball shape rather than a soccer ball shape. So, on Earth, there are always two tides - the one facing the moon and the one on the diametrically opposite side of Earth. The same goes for the moon and every other planet and satellite in the Universe (and stars for that matter). The effects, though, are at their most significant when bodies are close together.

To complicate matters further, the tidal bulges do not line up exactly with the centres of the Earth and the Moon. The Earth's rotation sweeps the near side bulge slightly ahead of the centre line and the far side bulge therefore lags slightly behind it. Both bulges have mass which, in turn, exerts a slight gravitational pull on the

years - over 100,000km! Indeed, early in its history, the Moon was 15 times bigger in the sky than it is today. Wouldn't that have been a sight to see?!

Gravity, of course, is not a one-way force - the Moon also pulls on the leading bulge as well. Since the Moon is "behind" the bulge (relative to the rotation of the Earth), it is pulling the bulge backward and slowing it down. Because of friction with the rest of the Earth, this slowing of the bulge actually slows the rotation of the Earth, making the day longer. The effect is small, but measurable.

Eventually, the Earth will become tidally locked to the Moon. The Earth's rotation will be slowed down so much that the tidal bulge will line up exactly with the centres of the Earth and the Moon. When this happens,

moon. Since the tidal bulge is ahead of the moon, it pulls the Moon **forward** in its orbit by a slight amount. This gives the Moon more orbital energy. Now, an orbit with higher energy has a larger radius, and so as the bulge pulls the Moon forward, the Moon moves farther away from the Earth. Surprised, huh? The rate at which the moon is moving away from the Earth has been measured as being a few centimetres a year. Not a lot, you might think, but it adds up to a substantial amount over 4 billion

the Moon will no longer be pulling the bulge back, and the Earth's spin will remain constant. When this happens, the time it takes for the Earth to rotate once will be exactly the same time it takes for the Moon to go around the Earth once! If you were to stand on the Moon and look at the Earth, you would always see the same face of the Earth. As a result, there would be places on the Earth where the moon will never be visible. What a vision the moon would be to travellers from the Earth's far side.

Back to the Point

Okay, that's tides explained but that doesn't explain why the moon keeps the same face towards Earth, I hear you cry! Hang on, I'm getting there. A consequence of tidal forces is that bodies of different sizes experience different accelerations which, in turn, alters the rotation rates of the bodies involved until a state of equilibrium is reached. This state of equilibrium occurs when the rotation rate of a body is the same as the amount of time it takes to orbit another body. What does all that gobbledygook mean in plain English?

Well, in this case, a body such as the moon, is in equilibrium when its day is as long as its year. Its tidal bulges are then pointed towards the centre of the body it orbits (not rotating fast enough to throw its tidal bulges forward of the planet-moon centre line). For the moon, its tidal bulges point towards the centre of the Earth. You can demonstrate this by swinging a bucket around your head. Uh oh, the men in white coats are back! Before you're dragged away again, your experiment shows that the bucket's open end always faces you - the bucket is tidally locked to your body!

This is what has happened to our Moon, it has become tidally locked and hence always shows its same face to us. Other moons around other planets in the solar sys-

tem have undergone the same process and are tidally locked to their planets. Double star systems can become tidally locked as well.

Here's another example to better illustrate tidal locking: Place a chair in the centre of the room - this represents the Earth. Next, walk around the chair so that you face it all the time. You'll notice that when you have walked around the chair once, you would have also turned through 360°, i.e., turned once about your axis. If someone is sitting on the chair, they will always see the same side of you - just as an observer sees the moon from the Earth.

Earth Moon Distance

Have you ever wondered how far away the moon actually is? Would you be surprised to learn that the distance changes over time (I'm not talking about the moon receding from the Earth here)? Almost all planets and satellites have elliptical rather than circular orbits. A circle is, essentially, a special kind of ellipse. An ellipse has two, what are called, foci. Their distance apart determines how flattened the ellipse is. In a circle, the two foci are at exactly the same position. relatively simple to draw an ellipse. Stick two pins in a board some small distance apart. Wrap a piece of string around the pins and have a pencil take up the slack. Then, keeping the pencil tight against the string, drag the pencil around the pins. What you end up with is an ellipse. How squashed the ellipse is depends on how far apart the pins were and the size of the ellipse is set by the amount of slack that was in the string. For satellites, the planet they orbit is at one of the foci (Earth is at one of the foci for the moon's orbit). For planets, the star they orbit is at one of the foci for their orbital paths (in Earth's case, the Sun sits at one of the foci).

Has Anyone Ever Seen a Meteor Strike the Moon? - Part II

In the early morning hours of Nov. 15, 1953, an amateur astronomer in Oklahoma photographed what he believed to be a massive, white-hot fireball of vaporized rock rising from the centre of the Moon's face. If his theory was right, Dr. Leon Stuart would be the first and only human in history to witness and document the impact of an asteroid-sized body impacting the Moon's scarred exterior.

Almost a half-century, numerous space probes and six manned lunar landings later, what had become known in astronomy circles as "Stuart's Event" was still an unproven, controversial theory. Skeptics dismissed Stuart's data as inconclusive and claimed the flash was a result of a meteorite entering Earth's atmosphere. That is, until Dr. Bonnie J. Buratti, a scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif., and Lane Johnson of Pomona College, Claremont, Calif., took a fresh look at the 50-year-old lunar mystery.

Buratti and Johnson's reconnaissance of the 35-kilometre (21.75-mile) wide region where the impact likely occurred led them to observations made by spacecraft orbiting the Moon. First, they dusted off photographs taken from the Lunar Orbiter spacecraft back in 1967, but none of the craters appeared a likely candidate. Then they consulted the more detailed imagery taken from the Clementine spacecraft in 1994.

Using Stuart's photograph of the lunar flash, they estimated that the object that hit the Moon was ap-

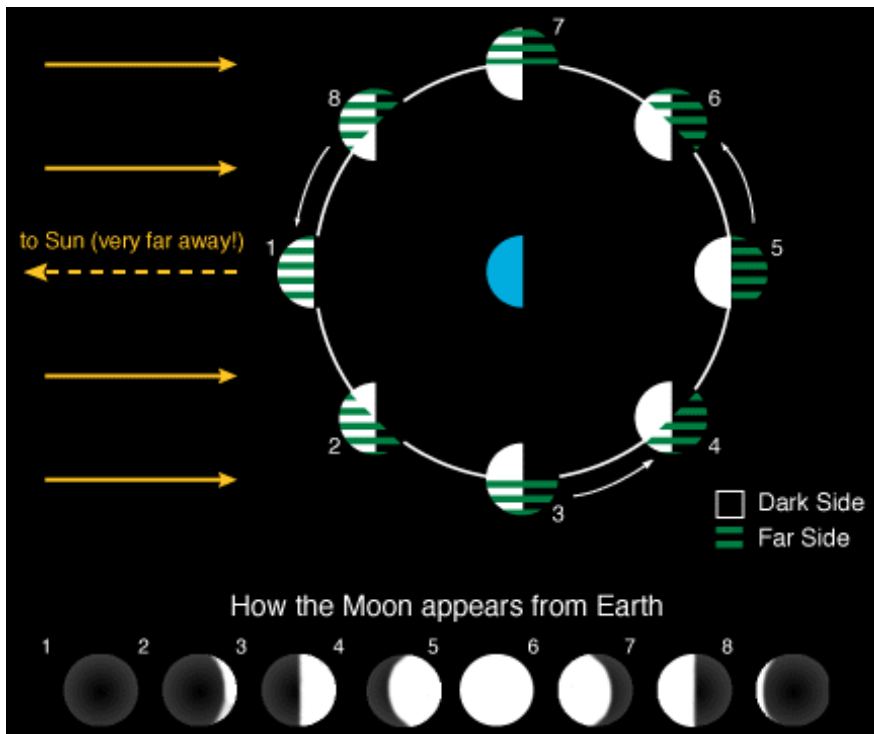
proximately 20 meters (65.6 feet) across, and the resulting crater would be in the range of one to two kilometres (.62 to 1.24 miles) across. They were looking for fresh craters with a non-eroded appearance.

Part of what makes a Moon crater look "fresh" is the appearance of a bluish tinge to the surface. This bluish tinge indicates lunar soil that is relatively untouched by a process called "space weathering," which reddens the soil. Another indicator of a fresh crater is that it reflects distinctly more light than the surrounding area.

Buratti and Johnson's search of images from the Clementine mission revealed a 1.5-kilometre (0.93 mile) wide crater. It had a bright blue, fresh-appearing layer of material surrounding the impact site, and it was located in the middle of Stuart's photograph of the 1953 flash. The crater's size is consistent with the energy produced by the observed flash; it has the right colour and reflectance, and it is the right shape.

Having the vital statistics of Stuart's crater, Buratti and Johnson calculated the energy released at impact was about 0.5 megatons (35 times more powerful than the Hiroshima atomic bomb). They estimate such events occur on the lunar surface once every half-century.

While Dr. Stuart passed on in 1969, his son Jerry Stuart offered some thoughts about Buratti and Lane's findings. "Astronomy is all about investigation and discovery. It was my father's passion, and I know he would be quite pleased," he said.



Top-down view of sun-earth-moon: It might be a bit difficult to visualise why we see different phases of the Moon. Take a look at the diagram to see how we come to see them. It's important to note that the Sun always illuminates half the moon and that we are seeing the moon from a different vantage point than the sun. As the moon goes through its orbit, the Sun illuminates a different section of the moon. It's exactly the same process as that which gives us day and night here on Earth. (Astronauts on the moon were able to see the Earth changing phase when they looked back at our planet!)

If you look at a diagram of the Earth-Moon system, you'll see that at some points in its orbit, the moon is closer to the Earth on average, and at other points farther away. There are terms to describe the point of

given all the variables involved!

Phases of the Moon

As mentioned earlier, watching the moon over succes-

nearest distance (Perigee) and farthest distance (Apogee).

The average distance is about a quarter of a million miles. Now the moon looks pretty big in the sky when full and the Earth looked even bigger in the lunar sky when the astronauts were looking back. But what is the scale of the earth moon system overall?

Well, if the Earth was an orange, the moon would be a cherry over 12 feet away! We tend not to appreciate what a quarter of a million miles really equates to. And think of the accuracy in getting something smaller than a speck of dust from our orange to our cherry 12 feet away, especially when the orange is rotating under its own steam and the cherry is orbiting the orange. It certainly makes one appreciate, all the more, the engineering feats achieved in getting 30 men from Earth orbit into lunar orbit

sive nights will show how the illuminated portion of face changes from night to night. This changing fraction is known as the moon's **phase**.

The moon, like the Earth, is a sphere and so, from anywhere on Earth, the Moon appears to be a circular disk which, at different times, is to a greater or lesser degree illuminated by direct sunlight.

Like the Earth, the Moon is always half illuminated by the Sun, but as the Moon orbits the Earth we get to see sometimes more, sometimes less, of the illuminated half. During each lunar orbit, the Moon's appearance changes from not being visible at all, to being partially illuminated, fully illuminated, then back through partially illuminated to not illuminated again. Although this cycle is a continuous process, there are four distinct, traditionally recognized stages, called major phases (New, First Quarter, Full and Last Quarter) and four other recognised phases. The two crescent and two gibbous phases are intermediate phases, each of which lasts for about a week between the major phases, during which time the exact fraction of the Moon's disk that is illuminated gradually changes. These phases describe two attributes: how much of the Moon is illuminated and the geometric appearance of the illuminated part. They and their sequence of occurrence (starting from New Moon), are listed in Table 1.

Did you know that a Full moon occurs at an instant in time - down to the second? So why does the moon appear to be full for several days in a row? because the percentage of the Moon's disk that is illuminated changes very slowly around the time of Full Moon (also around New Moon, but the Moon is not visible at all then). The Moon will appear to be fully illuminated only on the night closest to the time of the exact Full Moon. On the night before and the night after, it will be 97-



New Moon - The Moon's unilluminated side is facing the Earth. The Moon is not visible (except during a solar eclipse).



Full Moon - The Moon's illuminated side is facing the Earth. The Moon appears to be completely illuminated by direct sunlight.



Waxing Crescent - The Moon appears to be partly but less than one-half illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.



Waning Gibbous - The Moon appears to be more than one-half but not fully illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is decreasing.



First Quarter - One-half of the Moon appears to be illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.



Last Quarter - One-half of the Moon appears to be illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is decreasing.



Waxing Gibbous - The Moon appears to be more than one-half but not fully illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated is increasing.



Waning Crescent - The Moon appears to be partly but less than one-half illuminated by direct sunlight. The fraction of the Moon's disk that is illuminated.

Table 1: The eight "recognised" phases of the moon

99% illuminated although most people won't notice the difference. Even two days from Full Moon the Moon's disk is 93-97% illuminated and a casual observer will be hard pressed to notice that the moon is not full.

Lunar Month

A complete phase cycle takes an average of 29.5 days. The "age" of the moon is the time in days counted

from the last New Moon. That's why some people describe the moon as being 3 days old, for instance. Each complete cycle of phases is called a "lunation" - a lunar month, during which time the Moon completely circles the Earth in its orbit.

Observing Projects

Some religions, whose calendars are based on a lunar

Factino



identify a few major features [above picture].

Luna 3 followed closely on the heels of another Soviet probe, Luna 2, which became the first spacecraft to impact the Moon on September 13th of that same year.

The only people to have ever seen the far side side of the moon with their own eyes are the Apollo astronauts. They, and spacecraft, have taken images of the far side so that the rest of us can get in on the act. The first time human eyes ever viewed images of the far side of the moon was in 1959. The images were taken by the Soviet Luna 3 probe and radioed back to Earth. Lacking the digital image technology familiar now, Luna 3 took the pictures on 35 mm film which was automatically developed on board the spacecraft. The pictures were then scanned and the signal transmitted to Earth days later in what was perhaps also the first interplanetary fax. In all, seventeen pictures were received providing enough coverage and resolution to construct a far side map and

cycle rather than a solar one, place great emphasis on the first visibility of the crescent moon after a New Moon as this determines when a new month in their calendar begins. However, seeing a thin silvery crescent low in the western sky after sunset has its own observational delights. We'd like to hear from you if you try to spot these crescents and are successful, especially for the very thin crescents. If you're adven-

turous enough to take photos, send them in to us. We'll put them up on the [magazine webpage](#) and include the best we receive in the **Night Sky Observer** magazine.

Other projects to try are to draw or photograph the moon from night to night to see how the phase changes. (Again, send us your results) and to observe where on the horizon the moon rises from night to night. Try correlating these with how high the moon rises into the sky each night.

Astronomy Ignorance

Strange Astronomy Questions:

- 1) Is the Moon larger than the Earth?
- 2) Do the phases of Venus match the phases of the Moon? (strange thought?)
- 3) Is the Moon larger than the Sun?
- 4) You can't see the Moon during the day, can you?
- 5) Is the Earth bigger than the Sun?
- 6) Which is closer to us: Jupiter or that star next to it?

During an annular solar eclipse in El Paso a few years ago an amateur showed one 55-year-old woman the lunar shadow obscuring the sun's disk through mylar, filtered binoculars, and a filtered telescope many times over a 45-minute period. Towards the end of the eclipse, she turned to him and asked: "...now which one is the sun?"

At one public star night in an unnamed US society, someone asked what constellation the Big Bang happened in. This was right after one of their members had given a short talk about cosmology and what the

Does the Moon's phase affect the crime rate?

We've all heard stories about how loonies roam the streets during a full moon, causing mayhem and murder. Indeed, many police officers and emergency room personnel have noted that they become much busier and receive more calls around this time. Scientists have looked for a correlation between the phase of the Moon and activities such as murders, violent crime and births. Studies have, however, shown **no** such correlation, contrary to the beliefs of those involved. In other words, the Moon's phase doesn't appear to have any effect on the number of crimes committed or babies born.

So why do people apparently notice an increase in these events around the time of the full Moon? Social scientists speculate that it's because people are more likely to notice, and remember, a full Moon, rather than the Moon when it's in a different phase. So, if some strange murder is committed when the Moon is a crescent, folks dealing with the crime or its consequences may not remember the phase of the Moon that night. If, however, the Moon is full, a police officer might be more likely to remember it since the full Moon is bright and very obvious. So, while crimes, births, and strange occurrences happen all month long, only those that occur on nights with a full Moon are remembered when people talk about them.

"Big Bang" meant. Maybe the questioner had been daydreaming about donuts during the talk...

A amateur was showing some members of the public

Some Names for Full Moons

January:	Wolf
February:	Snow
March:	Worm
April:	Pink
May:	Flower
June:	Strawberry
July:	Buck
August:	Sturgeon
September:	Harvest
October:	Hunter's
November:	Beaver
December:	Cold

Is the moon's far side ever illuminated by the Sun?

The answer is: yes, it is. We never get to see the far side of the moon from Earth because the moon always keeps the same face towards our planet. But, because the moon is orbiting the Earth, it shows a different face to the Sun each day.

some of the brighter objects in the sky through his telescope. After looking at Jupiter and its moons, he was asked: "So how many moons does the earth have ?!"

That Earthrise Photograph

The Apollo moon program resulted in a legacy of thousands of images - all of them of immense value as both scientific and documentary records.

Yet 30-odd years after the event, most of them speak only as images from history. However, one particular Apollo photograph transcends all others, an image so powerful and eloquent that even today it ranks as one of the most important photographs ever taken.

The colour photograph is "**Earthrise**" - taken by Apollo 8 astronaut, William A. Anders on December 24, 1968, seven months before the first lunar landing. Although the photograph is usually mounted with the moon below the earth, this is how Anders saw it.

Apollo 8 was the mission which put humans into lunar orbit for the first time. Until then, no human eyes had seen the far side of the Moon - (all previous images of the far side of the moon had come from robot spacecraft).

Virtually all of the photographs scheduled for the Apollo 8 mission were to do with capturing high resolution images of the lunar surface - both of the far side and of potential landing sites on the near side.

The 'Earthrise' photograph was not on the mission schedule and was taken in a moment of pure serendipity.

In order to take photographs of the far side of the moon the Apollo spacecraft had been rolled so that its windows pointed towards the lunar surface. During this time, the Moon was between the spacecraft and Earth, effectively cutting-off all radio communication with mis-



sion control. As Apollo 8 emerged from the far side on its fourth orbit, crew commander Frank Borman rolled the spacecraft so as to position its antennas for radio contact with mission control. Looking to the lunar horizon for reference he exclaimed - "Oh my God, look at that picture over there! Here's the Earth coming up!"

The famous photograph that was taken in the next two minutes is usually credited to crewman William Anders, although commander Frank Borman has always claimed that he took it.

It turns out that in fact three photographs were taken, one in black and white and two in colour. The black and white shot was taken first - by Borman, and the two colour shots were taken moments later by William Anders.

The curious thing about the images is the difference in the way the two men perceived what they were seeing. Frank Borman related the 'Earthrise' to a moonrise on Earth, with the lunar surface horizontal and the Earth rising above it. But William Anders framed his photographs from the perspective of being in orbit about the lunar equator. So his horizon was the plane in which he was travelling. This meant he framed it so the edge of the Moon was vertical, with planet Earth a little to the left but with its North and South poles aligned the same way as the North and South poles of the Moon.

(It is interesting to note that the colour photographs taken by William Anders are almost always re-published with the image on its side - i.e. from the perspective that Borman adopted for his B&W photograph).

But regardless of which way the photograph was taken, the image shows our entire world as a small and blue and very finite globe, with our nearest celestial neighbour a desolate presence in the foreground.

US Nature photographer Galen Rowell has described this image as "the most influential environmental photograph ever taken". It is an image which still speaks to us today.



Darkness Over Africa

a total eclipse experience

By Angela O'Connell

Only a memory now, but a memory that returns with thoughts of the solar eclipse of December 4th, 2002. By amazing coincidence that Christmas eclipse crossed a similar path over Africa to the eclipse in the summer of 2001. The weather prospects however were not so good there, as it was the middle of the rainy season in December. Many people traveled to sunny summery Australia instead, another location where the eclipse would be visible.

I am prompted nonetheless to recall the summer of 2001 when I was drawn to the vast continent of Africa by the promise of a total solar eclipse and good clear skies. It is said that a total eclipse happens on average only once in every 400 years in any particular location. Hence the reason why I and some fellow members of the [Irish Astronomical Society](#) had travelled several thousand miles to Zimbabwe. Our aim was to be in the path of the moon's shadow when it passed over the sun on the 21st June, 2001, mid-Winter's day in the tropical and semi-arid climate of Zimbabwe. This pathway of darkness would only be 80 miles wide at the

maximum and it fell across the Zambezi river valley in the north of the country. Our destination, then for eclipse day was to be a remote rural part of North Eastern Zimbabwe, a four hour busride, 200km from Harare, the capital, where we were staying.

A level of anticipation about the eclipse had been building up. Eclipse chasers from all over the world were gathering to view the spectacle. On eclipse day we set off, from Harare, a convoy of eleven buses carrying about 400 people from [Explorers Tours](#). The highly



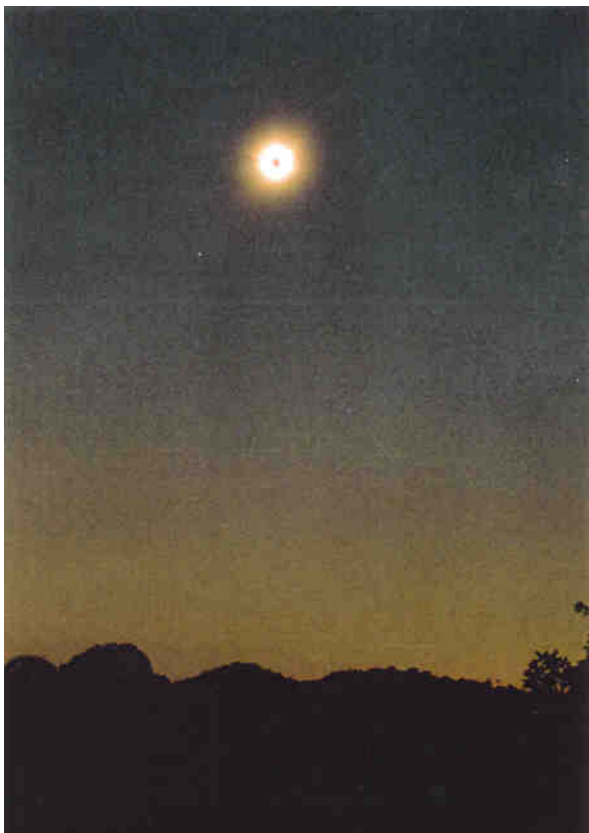
Myself and Patricia Carroll with some pupils from Maname School at the eclipse site.



Some of the Masai tribe, Amboseli National Park, Kenya.

visible buses created quite a sight as they passed along the unsurfaced roads raising clouds of dust in the very dry and bare landscape, prompting many curious natives to come out and wave. This was rural Zimbabwe, a miombo woodland wilderness dotted with termite hills and baobab trees and the occasional gathering of little round and sometimes square straw roofed houses where the people lived.

The eclipse site was very picturesque. It was in the grounds of the Maname school, situated alongside the Ruya River, a tributary of the Zambezi. We had no sooner arrived at the sandy river bed when first contact began and the moon's black disc started to eat its way into the sun. Over the next hour or so in the early afternoon, an eerie light began to descend over everything. A hush spread over the people present, colours intensified, the sky became bluer, the distant hills became dark and forbidding and the river became louder. The stage was set for the drama that was about to unfold with second contact, when suddenly the moon's shadow would sweep over the immediate landscape plunging everything into darkness. This sudden dark-



Landscape view of totality at the Ruya River, Maname School, northern Zimbabwe. Jupiter visible at 7pm position. Film, 200 ASA, F8, Lens 28mm, Exposure 1 sec.

ness can be so unexpected that it is not unusual to feel a sense of shock and disorientation. However the sound of the crowd cheering brings one back to earth.

Second contact began as the last rays of the sun's light formed a most beautiful diamond ring on the black disc

of the moon. When the sun disappeared, one had only a few minutes of totality to try and grasp the scene. The solar corona, a pearly luminescent light surrounding the black sun was an awesome site with its beautiful orchid shape and long streamers reaching out into the sky. The golden horizon, another characteristic of a solar eclipse added colour to this otherwise very dark eclipse.

Just over 3 minutes later, third contact came, ending totality with a sudden flash of light and the emergence of the sun's rays once again. Everyone was celebrating at this stage and fourth contact, when the moon entirely leaves the vicinity of the sun, was completely forgotten about.

During our time in Zimbabwe, we visited the Victoria Falls, one of the natural wonders of the world, we took a sunset cruise on the Zambezi River and became quite familiar with the hummock shaped hippos as they bathed in the water. Even warthogs parading around the hotel grounds with their young became a familiar site. No trip to Africa would be complete without doing a jeep safari. I was to become familiar with a lot of wildlife before I would leave; the lions in the Serengeti, the elephants at Kilimanjaro and the wildebeast at the Ngorongoro crater. Each was fabulous in its own right, but none compared to the eclipse at Maname School.

Did you know?

...that the maximum possible duration of a solar eclipse is seven minutes and thirty-one seconds and that the highest number of eclipses possible in a year is seven and the lowest number is two, both of which must be solar?



Diamond ring showing its development at the beginning of totality, 2nd contact. Film, 200 ASA, F8, Lens 200mm, Exposure 1/500 sec.



Diamond ring showing its development at the end of totality, 3rd contact. Film, 200 ASA, F8, Lens 200mm, Exposure 1/250 sec.

Choosing a Telescope

By Kevin Berwick

Although it is possible to have many hours of pleasure observing the night sky using the naked eye or binoculars, at some point in every amateur astronomer's career the decision is made to buy a telescope. The process of buying a telescope is a difficult one and mistakes can be expensive. Before you reach for your credit card, you really need to carefully weigh up some considerations.

Portability

Portability is a major issue. Differences in size and optical design create vast differences in telescope portability, and any telescope that you take out and use will be far better than one that sits in the cupboard because it is too heavy or too cumbersome.

Remember, the best telescope is the one that gets used most often. A small portable telescope with a fast set-up time will show you far more than an enormous light bucket which takes ages to set up and therefore is rarely used. Remember also, that if you live in a city, you may want to travel to a less light polluted site with your scope to take advantage of the dark skies. Obviously, the question that then needs to be asked is whether the telescope can fit in your car. Finally, remember that the telescope is only half the system, the mount must also be easy to set up if the system is to be easy to use. Alt-azimuth mounts, those which move up-and-down and side-to-side are probably best for portability but are useful for visual observing at low powers only since stars move in an arc across the sky,

necessitating movements both horizontally and vertically to track celestial objects. If you want high magnifications, or the option of doing some astrophotography, an equatorial is needed which can track the movement of stars with one motion. Unfortunately, the equatorial mount is considerably less portable and has a longer set up time than the Alt-azimuth mount.

Aperture

The most important thing in determining the optical performance of a telescope is the aperture, the diameter of the main lens or mirror within the telescope. The more light you can gather, the fainter the things you can see. In addition, larger telescopes have higher resolution, that is they can be used to observe finer detail on the planets or split tighter double stars. There are important qualifiers.

If a telescope is built badly the telescope will perform poorly. However, most manufacturers routinely turn out units that are reasonably good. Bad ones turn up, but major manufacturers will often fix or replace a poor telescope if you recognise that you have one.

Different optical designs perform differently. Schmidt-Cassegrains, Newtonian reflectors, and refractors all have good and bad points. Variations however, are relatively minor. It is usually adequate to assume that all well built telescopes of a given clear aperture and given quality of optical craftsmanship have a similar

optical performance: Real differences will correspond to changes in aperture of usually no more than 10% to 20%.

Atmospheric turbulence, known as **seeing**, limits the ability of a telescope to show detail, and sky brightness limits its ability to show faint objects. For resolution, i.e. seeing fine detail on the moon or planets or splitting close double stars, atmospheric turbulence usually means that an aperture of no more than 10 inches (250 mm) is useful under the typical Irish skies where I live. Your location may offer better skies and the possibility of regularly using a larger telescope. Poor seeing usually hits large telescopes harder than small ones. When seeing is poor, there may be no reason to take out and set up a big telescope. If you always observe from such conditions, you may have no reason to buy a big telescope. Yet, even in a bright sky, a large-aperture telescope will show fainter objects than a small one. Also, many of us have found dark-sky stable-seeing sites within a reasonable drive of home.

Notwithstanding these caveats, aperture wins big. If you buy the finest 4-inch (100 mm) apochromatic fluorite refractor in the world it will be beaten by an 8 inch Newtonian costing a quarter of the price of the refractor!!

Finally, it is worth noting that the quest for aperture unfortunately directly contradicts the desire for portability.

Performance

The most optical performance per unit of clear aperture comes from modern, high-quality apochromatic refractors but they are outrageously expensive compared to other designs of the same aperture. Also, in sizes much above four-inches in aperture, the tubes are generally

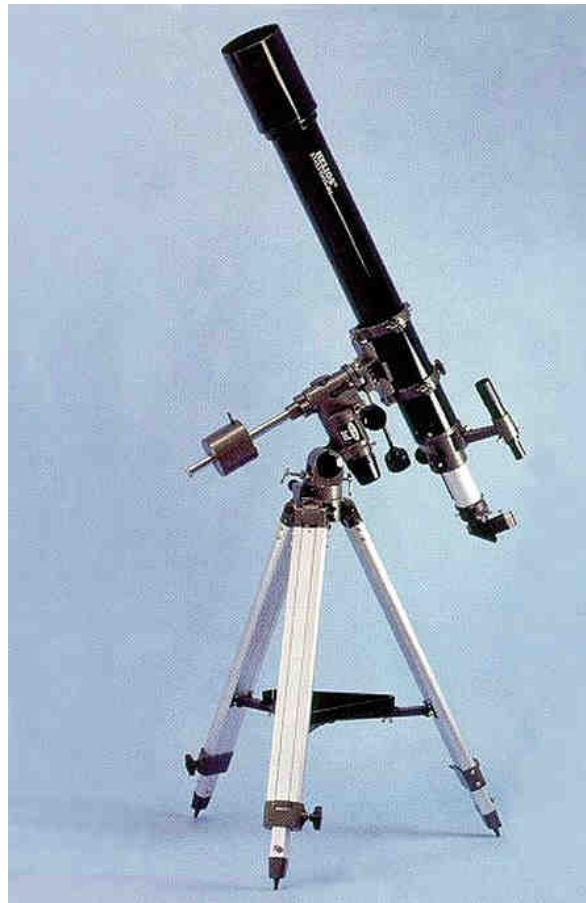
long enough to make the whole instrument cumbersome and heavy. However, these instruments excel at lunar and planetary work and apochromats, because of their wide flat fields, are often used for astrophotography.

The most optical performance per unit of portability comes from Catadioptric Schmidt-Cassegrain and Maksutov designs -- but they are still quite expensive. There's a qualifier here: What makes them portable are short, stubby tubes, but for apertures of four inches or less portability of all telescopes is dominated by the clumsiness of the mount, so the portability advantage of Schmidt-Cassegrains and Maksutovs diminishes. Catadioptric telescopes are a great all-round telescope and are probably the most popular world-wide at present.

The most optical performance per unit of cost comes from Newtonians on a Dobsonian mount. Compared to other telescopes of the same aperture, they are clumsier than Schmidt-Cassegrains and Maksutovs, but not nearly as awkward as equivalent achromatic refractors.

Price

It's fair to say that a decent telescope will cost of the order of a few hundred Euro (€) or Dollars, minimum, for something like a 6 inch Dobsonian reflector. A telescope such as this will show you many thousands of celestial objects and could keep you occupied for a lifetime. You may want Digital Setting Circles (DSC), a computer fitted to your mount which guides you to objects in the sky or even GOTO capability - just dial in the name of the object and the telescope will turn to the correct spot in the sky. If so, you will pay more. Prices start at about €900 for a Dobsonian telescope with DSCs and €1800 for a decent, 5 inch plus, GOTO scope. (U.S. prices for equivalent equipment will be lower, but that's another story). This may seem like a



Typical 102mm (4") achromatic telescope

lot of money but it's important to appreciate that a telescope is a lifetime investment. A good telescope will be useful in 100 years time. In addition, telescopes hold their value well; compare that to, say, a computer which will be both worthless and useless in about 5

years time!! Telescope prices are at an historical low at present as a proportion of wages. If you do decide that a few hundred Euro or Dollars is too much, please do not buy a cheaper telescope. You will inevitably be disappointed and will have wasted your money. Worse still, you will probably be put off observational astronomy for life, cutting yourself off from a hobby which can give you enormous pleasure. Make sure you avoid mass-marketed junk refractors 2.4 - 4-inch refractors, advertised as high-power and sold in department stores and camera shops.

Telescope Types

Achromatic refractors

Achromatic refractors are those with two lens elements at the front of a tube. They offer crisp, high contrast views due to their clear aperture; i.e. they have no central obstruction that reduces contrast. They also have a high transmission of > 90%. The light travels down the sealed tube only once so the impact of tube currents, which can degrade the image, is minimal. Refractors are durable, essentially maintenance free, and difficult to knock out of alignment. Small refractors, those with an aperture of less than 4 inches, often perform better than larger telescopes when the seeing is poor. It is worth saying that a 4-inch refractor is often said to offer comparable performance to an 8 inch reflector for the moon, planets and double stars. Good refractors with an aperture of 3-4 inches make excellent beginner's telescopes.

Achromatic refractors do suffer from chromatic aberration, bright objects like the moon and planets have a halo of false purple colour around them. The impact of this problem is, I believe, often overstated. Personally, I do not find this effect objectionable, however, some people do and it is worth looking at the moon through a few refractors before parting with your cash.

These telescopes can be bulky and difficult to mount well and the eyepiece position can be very low if you are viewing near the zenith, requiring the use of a star diagonal to relieve pressure on your neck. A star diagonal unfortunately flips the image left to right making it difficult to compare with star charts. Finally, a decent refractor can be expensive.

Manufacturers: Vixen, D and G, Meade, Celestron.

Apochromatic refractors

These are a modification of the standard achromatic refractors which use 3 or more lens elements, often using advanced optical materials, in order to reduce false colour from chromatic aberration and to minimise other aberrations also. These telescopes can also be



Typical 152mm (6") apochromatic refractor

made with very short focal lengths of c. $f/5$, meaning that the tube is very compact and highly portable. The images produced by this type of telescope are essentially perfect. Unfortunately, this perfection comes at a very high price, this variety of telescope is the most expensive per inch of aperture, typically costing up to €5000 (several thousand Dollars) for a 4-inch refractor. Often, an artificially grown crystal called fluorite is used as one of the glass elements on account of its excellent optical characteristics. Some concern has been expressed in the past regarding the durability of this material, however it is generally accepted nowadays that, with modern coatings, fluorite will last indefinitely.

Manufacturers: Astro Physics, Takahashi, Vixen, TeleVue, Borg, APM, TMB, Williams Optics and Meade(semi-apo).

Newtonian Reflectors

These telescopes have been a best-seller for over 300 hundred years, until the arrival of mass-market catadioptrics. Newtonians offer the most aperture per Euro/Dollar since they consist of only one precisely shaped mirror plus a flat. An 8-inch reflector costs less than half the price of a 4-inch refractor and images are 4 times as bright. The large aperture means that this telescope is ideal for deep sky work where aperture is at a premium. Since this type of telescope is all reflective, there is no chromatic aberration, apart from a residual amount generated within the eyepiece.

On the down side, these telescopes do need regular collimation since they can go out of alignment, particularly if transported. However, collimation is a simple, 2-minute procedure at the start of the evening's viewing and should not be seen as a huge drawback. Newtonian reflectors are large and heavy traditionally but, in recent years, the Dobsonian revolution has allowed the



200mm (8") Newtonian reflector

construction of enormous, 30-inch plus(!!!) telescopes while still retaining some portability. This is achieved

using very thin mirrors and a simple alt-az wooden mount. Newtonian reflectors are particularly susceptible to an optical aberration called coma, which stretches stars at the field edge into tiny comets. Curing this problem means either using expensive eyepieces or lengthening the f /ratio which compromises portability.

Manufacturers: Dark Star, Orion Optics, Parks, Beacon Hill, TAL.

Catadioptric telescopes

Catadioptric telescopes, those using a combination of lenses and mirrors, combine many of the best features of refractors and reflectors into one package, with few of their drawbacks. They allow the performance of a large aperture, long focal length telescope to be folded into a reasonably lightweight and transportable package - very helpful if the telescope must be taken to dark sky sites. Because of their optical design, catadioptrics are almost completely free of the coma found in reflectors and the chromatic aberration found in refractors. Stars are essentially point-like and coma-free across the visual field of a catadioptric scope, and there's no trace of coloured halos around bright stars and planets to mask faint details and colours. Some curvature of the field is often visible in catadioptrics - particularly in fast focal ratio models - but it usually shows more at the edges of wide field photos than in visual observing. The typical catadioptric fork mount cradles the telescope's short optical tube securely on two sides, reducing image-degrading vibration to a minimum. Its power-driven right ascension setting circle keeps pace with the motion of the stars, allowing the observer to find faint deep space objects by their celestial co-ordinates alone, without the constant manual readjusting needed with the right ascension circle of most refractor and reflector mounts. A catadioptric's slow motion controls, often not available on reflectors,



235mm (9.25") Schmidt-Cassegrain reflector

makes the "fine tuning" of the telescope's position easy. And a catadioptric's set-up and takedown time is short, due to its folding tripod, lighter weight, and more compact size per inch of aperture. There are loads of electronic/optical gizmos available for this type of telescope. Since they have a sealed tube, there are no tube currents and recoating is not required. Dew can be a problem since the thin corrector plate can lose

heat very quickly.

The Schmidt Cassegrain is the most popular type. The Maksutov is a variation with a differently shaped corrector. The 'Mak' offers excellent image quality :- refractor like, although the thick corrector can cause thermal stability problems. In the past, these have been expensive but now Meade and Russian-built versions have lowered the price greatly.

The catadioptric's drawbacks? First, the cost. An 8" Schmidt-Cassegrain costs 50% to 300% more than an 8" reflector, although about the same as a good 4" achromatic refractor. Schmidt-Cassegrain catadioptrics do not have as wide a contrast range on the Moon and planets as a refractor or most $f/6$ to $f/8$ Newtonian reflectors, because of the extra light scattered by its larger secondary mirror and its multiple-element folded light path, nor will it be able to split close binary stars as cleanly. However, a Schmidt-Cassegrain will usually outperform a fast ($f/4.5$) focal ratio reflector of similar aperture on the planets and binary stars due to its lack of diffraction-causing secondary mirror spider vanes.

Although their large apertures allow detailed deep space observing, catadioptrics generally do not have as bright an image as other scope types of similar aperture at the same power. Also the focussing is done by moving the primary mirror which can cause annoying image shift during focussing.

Finally, because of their eyepiece location at the bottom of the optical tube, catadioptrics on German Equatorial mounts are somewhat less comfortable to use than reflectors on similar mounts - when observing at the zenith, catadioptric eyepiece will typically be at waist level, moving to normal eye level only when the scopes are pointed towards the horizon. The eyepieces



200mm (8") Maksutov-Cassegrain reflector

of fork-mounted catadioptrics are always at more or less eye level, no matter where the scopes are pointed, and are therefore more accommodating for visual observing.

Despite these drawbacks, if it fits your budget and you need a portable scope that does it all, you would be hard-pressed to find a better all-around investment than a good catadioptric.

Manufacturers: Meade, Celestron, Orion Optics, Vixen, Takahashi.

What would you recommend?

Below, please find some personal recommendations, reflecting my own deep seated and, quite possibly irrational, prejudices!

Portable 6-8 inch Meade/Celestron/Darkstar Dobsonian...Digital Setting Circle compatible, simple and relatively cheap. 4 inch Vixen achromatic refractor

on GP equatorial mount...nice optics and excellent mount.

Celestron Nexstar 5 - GOTO capability and nice optics in a highly portable package.

8-inch Meade LX / Celestron. Catadioptric telescopes from the Industry giants. Great if you can set it up on your own. Try a 'dead lift' of the tube and fork onto the tripod at 2.30 am before committing to this scope.

Summary

- Analyse your lifestyle first. Minimise the set-up.
- Don't buy in a camera shop / catalogue shop:- buy from a dedicated telescope shop.
- Spend as much as you can. Ignore accessory bundles. Note the resale value. Don't overspend.
- Make sure you can find objects, consider Digital Setting Circles or GOTO if you can't.
- Avoid 'aperture fever'.
- Telescopes are heavy. Watch your back.
- Don't buy a 60mm refractor or a 4 inch reflector..... Like I did!
- Forget astrophotography... for now.

Resources

The best up to date information is on the Internet, via the Web or newsgroups on USENET.

Internet:

<http://www.scopereviews.com>
<http://www.cloudynights.com>
<http://www.weatherman.com>
<http://www.astronomics.com>
sci.astro.amateur on USENET

Suggested Reading

'Starware', by Philip Harrington, 2nd ed, Wiley

A Word to the Wise

In 1966, a NASA team doing work for the Apollo moon mission took the astronauts near Tuba City where the terrain of the Navajo Reservation looks very much like the Lunar surface. Along with all the trucks and large vehicles, 'there were two large figures dressed in full Lunar spacesuits.

Nearby a Navajo sheep herder and his son were watching the strange creatures walk about, occasionally being tended by personnel. The two Navajo people were noticed and approached by the NASA personnel.

Since the man did not know English, his son asked for him what the strange creatures were and the NASA people told them that they are just men that are getting ready to go to the moon. The man became very excited and asked if he could send a message to the moon with the astronauts.

The NASA personnel thought this was a great idea so they rustled up a tape recorder. After the man gave them his message, they asked his son to trans-late. His son would not.

Later, they tried a few more people on the reservation to translate and every person they asked would chuckle and then refuse to translate. Finally, with cash in hand, someone translated the message: "Watch out for these guys, they come to take your land."

Building Your Own Observatory

(or maybe that should be how NOT to build your own observatory...)

By Gary Nugent

If you own a telescope, you're familiar with how long it takes to set up your scope for an observing session. How many times, though, have you found that just as everything is ready, the clouds roll in? Or worse, it starts to rain and you make a mad dash to get the scope under cover possibly knocking something over in the dark during your flurry of activity?

Given the climate and weather in my part of the world (Ireland), the above scenario is all too common. And, if it happens too many times, you might be tempted not to use the scope at all because you're likely as not to have to lug it back into the house just after you've gone to the trouble of setting it up. I sometimes wonder how many telescopes languish in bedrooms, kitchens or garden sheds for this very reason.

And if you think that the time spent setting up a basic telescope is too long, imagine what it takes to configure a telescope with a GOTO system, especially one that's properly polar aligned. And then add to that the time involved in getting the system ready for some CCD imaging. With my weather, that's just asking for trouble!

Being interested in film and CCD astrophotography, this was the situation which I faced back in 1999. Learning the ropes in CCD imaging meant the CCD setup alone

could take anywhere from 30-60 minutes! (Experience has since refined that time down to 10-15 minutes). A number of factors soon convinced me that what I really needed was a permanent observatory. Some of these factors included: an ability to quickly cover all exposed equipment in the event of rain; protection from the wind; somewhere to leave the telescope permanently set up in readiness for the next observing session and an external mains outlet to power items such as the CCD camera and laptop. The telescope GOTO system is powered by a car battery - a heavy enough item which I didn't want to lug from the house to the bottom of the garden and back again at the end of an observing session.

My telescope came with a field tripod - a reasonably sturdy aluminium affair that is fine for field work; i.e. bringing to a dark site and performing simple visual observations. However, it's not really suitable for a permanent setup. Kicking one of the legs in the dark would be enough to put it out of alignment, especially where the fine tolerances of CCD imaging are concerned.

Realisation

It soon became apparent following numerous setups and breakdowns of the equipment in the back garden that a lot of observing/photographic time was being

lost in these exercises let alone the chore it can become in packing everything away when you're exhausted and the only thing you want to do is go straight to bed.

So I began contemplating the idea of building my own observatory. Now my DIY abilities have been confined to a number of unfinished projects (like building a coffee table or a TV/video unit) and a couple of projects that did see fruition - a small bookcase and a Pergola out in the back garden. The fact that the pergola was still standing two years after I built it, despite howling gales and such suggested that my meagre skills might just extend to building an observatory after all.

The DIY Approach

A couple of years back, I attended a basic woodworking course in the hopes of picking up some simple skills. The fact that the lecturer's first words were: "Welcome to the woodwork course. The first thing I want you to know is that I'm not going to teach you about making joints. Just tell me what you want to build and I'll help you as best I can." didn't fill me with confidence. Maybe I'm naive, but I figured woodwork is all about joints because that's what holds everything together. Needless to say I didn't stay too long on that course. That and the lecturer's obviously increasing ineptitude sealed its fate.

What little woodwork skills I do have I've picked up from reading a number of books on the subject. That and having the right tools (not trying to hammer in nails with the blunt end of a screwdriver, for instance), were the key to this project.

I hunted around the Internet and in old astronomy magazines for articles written by anyone who'd attempted something similar. It came down to two basic



The re-excavated pier hole which was widened to 1 metre (3 feet) from 60cm (2 feet), The remainder of the original DIY metal tube still protrudes from what's left of the concrete.

designs - either the observatory would have a dome or a roll-off roof. I didn't fancy the logistics involved in designing my own dome and commercial units were just too expensive. Besides, whatever dome I would have ended up with would require some mechanism to rotate it synchronously with the telescope. That was way beyond my capabilities.

The roll-off roof design comes in various guises. It has the advantage of being relatively easy to build and, once the roof is rolled off, there are no worries about

the opening having to track with the telescope. So that was the design I decided to go with.

Finding the Best Location

Before doing anything, though, I had to choose a site in the garden that was reasonably protected from street lights and neighbour's security lamps. Fortunately, the garden is sunken - not by design but by subsidence - which affords protection from security lamps. Street lights are a different matter. Four such lamps shine into the garden. At three positions in the garden,

trees and bushes provided some shade from the lights, but at each position, one street light (a different one at each position!) was still intrusive.

One position provided a view primarily of the northern sky. Bushes blocked out the southern sky and the house blocked the western sky. Since Dublin city washes out the northern sky with light pollution and there was no view of the southern sky, this site was rejected. The second position afforded a good view of the eastern and northern sky but not to the south or west. This site was rejected as well. The third position provided good views of the southern sky, very little of the northern and some of the eastern and western sky. This was the site I chose to use for the observatory.

Before I could build the observatory, I would have to find a suitable permanent mount for the telescope. I decided to build a mount myself (in true DIY fashion). All the articles I'd read on this subject suggested sinking a metal tube into 60cm-100cm (2-3.5 feet) deep concrete. To cut down on vibration, the tube should also be filled with concrete.

Not According to Plan

This is where I first went wrong. The widest tube I could find was 90mm aluminium piping. I sank this into concrete that was 60cm deep (I couldn't dig any deeper - the soil was thick compressed clay). The hole I dug was 60cm square. The tube was then filled with concrete. I custom built a mount head out of hardwood into which the telescope drive would fit. The tripod legs were removed from the field tripod assembly and the remaining section and drive was seated into the hardwood mount. Bolts secured the drive to the mount via the original fixing holes for the aluminium tripod legs.

I have to say I was very pleased with the wooden



The professionally manufactured pier mounted atop the plate that's been buried in the relaid concrete. The pier is attached to the plate by four bolts.

mount. Tolerances were very tight and there was no play between the drive and mount head once the bolts were tightened. The whole assembly was solid. That night was clear so I got to try out my handiwork. Well, what can I say ... what a comedown. Stars were bobbing about all over the place. I checked all the bolts were tight and still stars danced in the eyepiece. The damping down time was long too - about 7 or 8 seconds. A light tap on the aluminium tube or wooden

mount head confirmed my worst fears - the mount I'd built was the source of the problem. Instead of quickly damping out vibrations it was exacerbating them. It was as if the tube was 'ringing' after being tapped.

Bringing in the Professionals

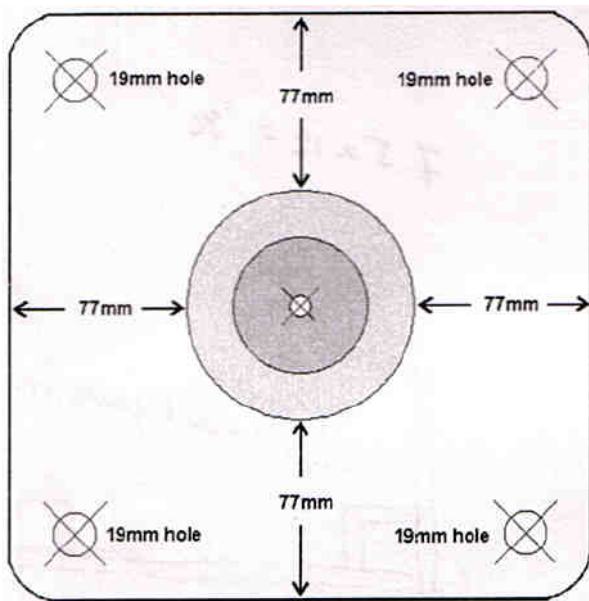
It was time to go back to the drawing board. In my case, the DIY approach hadn't worked. I began looking through the magazines for suppliers of telescope piers.

I own a Vixen telescope and I found that Orion Optics; in the UK sold a pier for my scope. Unfortunately, however, they don't export Vixen equipment outside the UK and the vendor I originally bought the scope from didn't sell the pier as a separate item! I scouted about for independent pier manufacturers but, surprisingly, couldn't find one in the UK. [AstroPier](#) in the USA could have supplied a pier for a few hundred dollars but they would have had to build it to order as Vixen is not one of the manufacturers they support off-the-shelf. In any case, the \$1500 shipping charge seemed a tad too expensive.

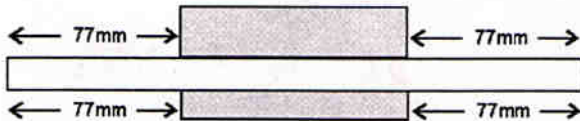
I'd have to look closer to home for a solution. I remembered that a friend of a friend owned a metal tooling shop. If this guy could make Klingon B'athleth's from solid titanium I figured he could manage a telescope pier. I looked at lots of pictures of custom built telescope piers before submitting a design to him. There was some to-ing and fro-ing about fine details and design clarifications. In the end I made some concessions to my design on the basis of cost. He built the pier out of scraps of tubing, steel plate and bits and bobs left over from other projects. A docking ring (to mate the telescope drive with the mount) was custom tooled. A week after submitting the final design, the finished pier was delivered to my door. The total cost was £250 (about \$350), amazingly cheap given the materials and work involved but the price was kept low due to the use of 'offcuts' for want of a better word.

The Pier Arrives

The pier came in three pieces - a bottom plate which would be buried in concrete, the pier tubing which was connected to the base plate by four sturdy bolts (allowing adjustments to be made to the tubing so it could be set vertically) and a top plate onto which the telescope drive would be placed. The top plate was



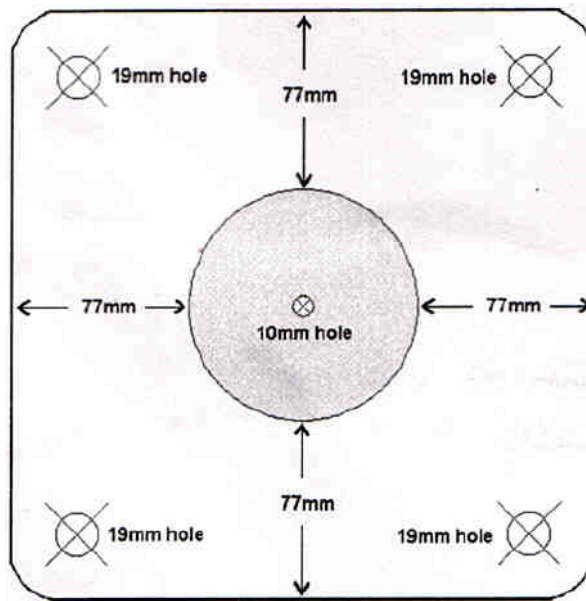
Position of the docking ring as welded onto to top of the telescope mounting plate. The ring is centred on a 10mm hole at the centre of the plate (top-down view). The drive head of the Vixen GP mount sits snugly into the ring.



Positions of docking ring (top) and support ring (bottom) as welded onto the telescope mounting plate. (Side-on view).

also connected to the tubing by four bolts, allowing the plate to be levelled prior to the telescope drive being attached.

There was a problem I had to contend with before in-



Position of support ring - a solid ring of steel with a 10mm central hole as welded to the base of the mounting plate. A large screw passes through the ring and plate and into the base of the drive head. A large knurled knob is used to tighten the screw and locks against bottom ring. Loosening the screw allows the drive head to be rotated sideways when setting up polar alignment. (Bottom-up view)

stalling the new pier - removing the old one. Let me tell you, hacking out 0.216 cubic metres (8 cubic feet) of concrete with nothing but a sledgehammer and stone chisel is not for the fainthearted. Several hours (and mashed fingers) later, the original hole was re-excavated and enlarged to be 1-metre in diameter.

The hole was then refilled with fresh concrete and the pier baseplate submerged just below the surface. The four attached bolts protruded from the concrete in

readiness for the pier tube once everything had set solid.

Testing the Result

A couple of days later, enough time for the concrete to have hardened, the pier was mated to the baseplate and vertically aligned. The top plate was then added and levelled using a spirit level. That night the telescope drive and OTA were mounted onto the completed pier. This time, the construction proved to be rock solid. Tapping on the pier didn't result in dancing stars. A sharp rap to the pier did cause vibrations, as expected, but they died out in about a second.

With the pier construction completed, all that remained was to build the observatory around it. It was time to put my meagre skills to the test....

Ursa Major

I was in my observatory one night taking some photos when the spotlights on the house came on and I could see a shadow moving in my direction. I was somewhat upset at my wife for turning on the lights and coming out to my sanctuary when she could have called me on the intercom. Then this large black bear moved into view. I thought Oh "oh s...", he looked at me and I looked at him -- and he ambled down the drive and left. There is also a set of motion lights on the house and my wife was innocent. Nice bear! That was last year - this year we have had several bear visits and I carry a 24 inch flashlight to and from the observatory. It makes for a good club, I hope!

- Allen Ebeltoft

The Forgotten Astronomers

By Tim Carr

Even those people who know nothing about astronomy (and there are plenty of them, it would appear) have heard of Galileo and how he changed our view of the heavens. They've probably heard of Copernicus, Newton and his apple and maybe even Kepler, the codifier of the laws of planetary motion. But just how many of them are familiar with names like Ulugh-Beg, Nicholas of Cusa, Olbers, Lemaitre and so many others who made astronomy what it is today? Not too many is the answer. Of course we live in an age when it is actually considered seriously un-cool to know a lot about the heavens, or any science for that matter. But if you're reading this then like me you're one of those people who actually enjoy learning. These articles tell the story of some of those people who may not be household names but still made a contribution to our knowledge of the stars. I hope you enjoy them.

Ulugh Beg

The great Mongol empire was not noted for its scientific achievements and with good reason. But in 1428 Tamerlane's grandson Muhammed Targai Ulugh-Beg, who was governor in part of central Asia, established an astro-

nomical observatory at Samarkand. As the telescope was still centuries away, astronomers had to content themselves with naked-eye observation. He published a star map with 994 stars, the first since that created by the great Greek, Hipparchos, in the second century B.C. His version of the Ptolemaic tables was more accurate than the originals themselves but, despite all this and even becoming emperor in 1447, there was nobody in Mongolia to follow up his work and he has all but disappeared from the pages of history.

Several books on the Mongols I consulted don't even mention him. He published in Arabic and was translated into Persian but not Latin, at least until 1665 by which time his work had been eclipsed by others. Coming from a culture which placed little emphasis on science his work died with him. Ulugh-Beg was killed by his son on October 27th, 1449. He was fifty-six.

Nicholas of Cusa

You might think that anyone who published a book in 15th century Europe, saying that the Earth was just another world orbiting the sun rather than the centre of the universe, might run foul of the Catholic Church very quickly. That is just what the German cardinal Nicholas Krebs did in 1440 more than a century before Copernicus. So why have we never heard of him?



Ulugh Beg

Nicholas was born in Krebs in the Rhineland in 1401 and after graduating with a law degree he decided to enter the church. One of those people who seemed to be interested in many things, he made glasses for short-sighted people, suggested taking the pulse as a diagnostic aid and was an early advocate of observing and experimenting.

This might sound like the most basic of common sense but it would be a couple of centuries before Galileo could convince the world that it was worthwhile to examine nature at all. In his book, Nicholas said that the Earth orbited the Sun, space was infinite and concepts like 'up' and 'down' were essentially meaningless and the stars were themselves suns with planets orbiting about them.

The Catholic Church which would later burn Giordano Bruno and condemn Galileo for saying much the same things was, in the 17th century, much more relaxed about such things. Nothing happened to Nicholas, good or bad. Like Ulugh-Beg, history has forgotten him because, unlike Galileo, he could not back up his ideas with proof. He died in 1464.

Rene Descartes

If Nicholas and Ulugh-Beg weren't famous then this man certainly was, and still is. The "father of modern philosophy" and brilliant mathematician has an honoured place in European history but what you might



Nicholas of Cusa



René Descartes

not know is that he also tried to reconcile the church and the Copernicans as to which world-view was correct.

In 1612, at the age of 16, Descartes attended university in Poitiers, graduating four years later as a lawyer. The telescope had just been invented and Galileo

before, used one to revolutionise our understanding of the heavens. But the church had changed its attitude to such ideas and when Galileo was condemned in 1633, Descartes decided against publishing a book supporting the Copernican system. Instead, in 1644 he published his **Principia Philosophiæ** in which he said that the Earth was indeed stationary because it was being carried around the Sun amid a vortex of small particles in which it did not move. Space was filled with such vortices made up of particles of different sizes. As they collide they produce fine dust which settles in the center forming a star. His theory went on to account for planets and comets. Due to his well deserved reputation, this view held sway for many decades in his native France and helped keep Newtonian physics from being more widely accepted. Descartes' influence was long lasting, if for all the wrong reasons.

Johannes Hevelius

At the western edge of the Sea of Storms on the Moon, there is a crater named Hevel. Seventy miles wide, its walls are 6,000 ft high in places and a good telescope will show a fine system of rilles on the crater floor. It is

named after a German astronomer called Johannes Hevel (or Hewelcke) who was born in Danzig in 1611. By day he was a successful brewer and member of the city council but his nights were spent in his rooftop observatory, which was perhaps the best in Europe, using the telescopes he himself made to map the Moon in greater detail than ever before- The Moon had been studied before of course, most notably by Galileo but the great Italian's drawings were crude compared to the ones Hevelius made. In 1647, he published the *Selenographia* - an atlas of the Moon based on observations made over a decade. He was the first person to realize that the dark features were low-lying areas which he called maria (seas) and that the brighter ones were uplands. We now know that the maria are as dry as a bone (much dryer, in fact) but he was right about the elevations and measured the heights of the lunar mountains quite accurately. The names of the major

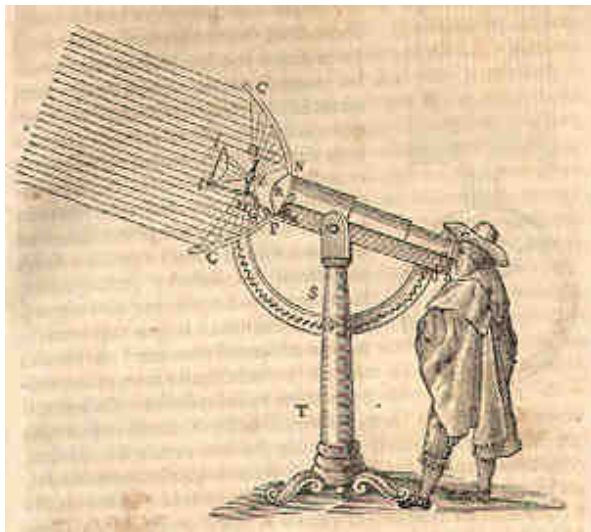


Illustration from René Descartes' Principia Philosophiæ

plains and mountains he used have survived to this day.

As well as the Moon, he also observed the phases of Mercury, worked out a close value for the rotation of the Sun and discovered what he called 'faculae' - the bright regions on the surface of the sun associated with sunspots.



Johannes Hevelius

As if all that wasn't enough, he discovered four comets and published two books on the subject. Like the Italian mathematician Giovanni Borelli, he thought that comets went around the Sun in a parabolic path. In 1657, he began what was to be the most comprehensive mapping of the sky yet undertaken but in 1679 his observatory burned down. Nevertheless he could still publish 'Uranographia' containing 1500 star co-ordinates. Hevelius did not use his telescopes at all for this work, despite such luminaries as Edmund Halley encouraging him to do so. Even half a century after the invention of the telescope, many astronomers felt that they could not trust it to produce accurate enough images for something as demanding as a map of the stars.

Ole Romer

In 1676 a thirty-two year old astronomer from Denmark stood up in the Academy of Sciences in Paris and announced that he had made a discovery. Some people in the scientific community, such as Newton and Halley, paid attention to him; some, like the director of the



Ole Romer

Paris Observatory, Giovanni Cassini, didn't. But what Romer had said was in fact of the most profound importance, not just to his field of work but to science in general.

Ole Romer had discovered the speed of light.

Born in Jutland in 1644, he studied under the Bartholin brothers who taught physics, mathematics and astronomy.

During 1671, when Jean Picard travelled from Paris to do some work relating to Tycho Brahe's observations, Romer assisted him so ably that Picard took him back to Paris to work in the Academy. Rising quickly through the ranks, he became tutor to the Crown Prince and spent his time improving the accuracy of both observations and the instruments with which they were made.

His magnum opus, however, concerned eclipses of the innermost of Jupiter's moons, Io. Romer noticed that when Earth and Jupiter were farther apart, the eclipses took place later than when the two bodies were closer. The length of time it took for the event to happen was the same, but when Jupiter was close to us we saw it sooner than conventional wisdom said we should.

Romer realised that we could see the eclipse sooner than expected when Jupiter was closer, simply because Jupiter was closer. The light got here more quickly, just as two bullets fired at the same target from different distances won't arrive at the same time. The one fired from the gun closer to the target will obviously arrive

first. The logical answer was that light must have a finite speed, just like everything else. The value he came up with was about 225,000 Km/sec. which is pretty close to the actual speed of 300,000 km/sec.

Well, obviously, says you. But it is only obvious because Ole Romer figured it out for us. Today, we take the fact that light has a finite speed for granted but in the Europe of the seventeenth century, many still assumed that light moved at infinite speed. People were still coming to grips with the fact that old assumptions, widely accepted without question, might not actually be true. It would be many years before Newton's Principia completed the triumph of the scientific revolution. Although his mentor, Picard, was among a number of influential names to support his findings, many in France were less impressed. The great Rene Descartes said that light travelled at infinite speed, as did Aristotle. Who was this Ole Romer anyway? Eventually, Romer was appointed Astronomer Royal in his native Denmark, and even served a term as mayor of Copenhagen, but it would be another half a century before James Bradley's work on the aberration of light confirmed the truth of Romer's idea. Ole Romer died in 1710 aged sixty-six.

James Bradley

Being a contemporary of Isaac Newton and Edmund Halley is not a recipe for fame but James Bradley was not the sort to worry about such things. His contribution to modernising astronomy speaks for itself. Born in 1693, he studied theology at Oxford but developed a fascination for astronomy from his uncle, James Pound, who was a friend of Halley. Despite a steady career in the church beckoning, he resigned his position as chaplain to the Bishop of Hertford and became professor of astronomy in Oxford in 1721 and never looked back.

What Bradley wanted to do was to prove that stars showed parallax in their positions as the Earth moved around the Sun. One of the objections to the Copernican system was that there was no observable shift in the observed positions of the stars as the Earth moved from one side of its orbit to the other. A shift by the observer of many millions of miles should result in the stars' position 'appearing' to move very slightly. Now this had occurred to Copernicus (and to Aristarchus, who, thousands of years ago also said the Earth orbited the Sun) but both realised that the parallax effect could not be seen as the stars were just too far away for any equipment to measure it. 'Well you would say that wouldn't you', said the church. Very convenient.

Bradley realised that the accurate measurement of parallax would not only silence some of the critics but, more importantly, give astronomers an idea of just how far away the stars were. Using a telescope with a focal length of over two hundred feet, he soon discovered the long elusive parallax. The problem was that not only was the displacement too big it was in the wrong direction!

In 1728, after a couple of years of this, he realised that the cause was the movement of his observation platform - the Earth itself. By tilting the telescope to compensate, he got more accurate results.



James Bradley

Sadly, however, a value for stellar parallax was still beyond him. But in discovering this 'abberation' of starlight and measuring it (between 20 and 20.5 seconds of arc), Bradley had done two important things. The ratio between the speed of light and the speed of the Earth's orbit confirmed Romer's value for the speed of light. Also, the very fact that light was showing any aberration at all, proved that the Earth must be moving in space.

Although this was by far the most important work of his life, Bradley was not finished there. His meticulous measuring of stars was upset by tiny shifts of the Earth's axis, caused by the gravitational pull of the Moon. This effect is called nutation and requires accuracy in measurement of two arc-seconds. As even this level of accuracy was insufficient for detecting stellar parallax, it showed that the stars were truly a very, very long way away. These results were only published in 1748 after nearly 20 years of measurements. That same year, he received the Copely medal for his work.

In 1733 he made the first accurate measurement of Jupiter's diameter, disabusing scientists of the notion that their world was anything special. In 1742 he was appointed Astronomer Royal. James Bradley died in 1762.

Astronomy Students Say The Strangest Things!

During lunar eclipses, the moon travels around the sun preventing light to the earth. During Solar eclipses, the earth travels around the moon.

Drift Method of Polar Alignment

Set up your scope as normal. Use one of the many methods to roughly align using Polaris. This can be as rough as just getting Polaris in the centre of your finder scope. The closer you get here, the shorter the time you will spend drifting. If you're using a tripod, level it first - it makes life easier.

Put a diagonal and illuminated guiding eyepiece in your scope. (Omit the diagonal for a Newtonian.) About 200 power is the minimum needed for adequate sensitivity during drifting. Rotate the eyepiece so that a star moves parallel to the crosshairs in Dec and RA when using the slow motion controls. Align it so that Dec is up and down (North & South) and RA is right and left (East & West).

Find a star very near the meridian and about $+20^\circ$ declination and align it to the center of the guiding eyepiece. Let your scope track (you may guide in RA only if you wish) and watch for Dec drift (up or down). Unless your alignment is very close, you will see drift in 5 to 30 seconds.

If the star drifts up, turn the azimuth knob that makes the star move right in the field. If the star drifts down, turn the azimuth knob that makes the star move left in the field (These adjustments are reversed for a Newtonian). After adjustment, use the slow motion controls to re-center the star. Repeat this until there is no drift for at least 5 minutes. Note: If you see drift in less than 5 seconds at 200X, you are probably 10 or more eyepiece fields off in azimuth. Give the knob a good crank. This may have to be repeated 3 or 4 times to notice the drift slowing. If you don't see any drift for 30 seconds or so, you may

only be 1 or 2 eyepiece fields off. Make your azimuth adjustment accordingly. If after adjustment the star drifts in the opposite direction, you went too far.

Find a star 15° to 25° above the Eastern horizon and about $+20^\circ$ declination. Repeat (2) and use the guidelines from (3) and (4). If the star drifts up, adjust the elevation to move the star down. If the star drifts down, adjust the elevation to move the star up. Repeat until there is no drift for at least 5 minutes. (Note: You may use a star in the west instead of the east but the adjustments must be reversed, that is, if the star drifts up, adjust the elevation to move the star up and if the star drifts down, adjust the elevation to move the star down.)

If you made a large correction in elevation (several degrees or more), go back and check the azimuth, otherwise you are done. With a little practice, it ought to be possible to complete the procedure before the end of twilight. Try it in your back yard until you are confident. This method is usually accurate enough for astrophotographs of up to 3 hours duration for small fields (less than 1 degree) and up to 2 hours for larger fields (up to 5°) for declinations between $+70^\circ$ and -70° . For exposures longer than these and closer to the poles, a photographic method of polar alignment that is applicable only to permanent installations may be required.

It must be emphasized that the star cannot drift at all for 5 minutes to achieve the exposure times stated above. If you judge the drift by bisecting a star with a line in an illuminated eyepiece the star must stay bisected for the full 5 minutes. Experience has shown that if the star has drifted as little as half its diameter then field rotation will begin to creep into long exposures.

Coronado SolarMax 90

H-alpha system

- A Review

By Kevin Berwick



Introduction

I recently decided to buy a [SolarMax 90 filter](#) from Coronado. Before I launch into the review proper, you may be interested to hear about the process which lead me to the purchase of this filter, and my current 'observing lifestyle' for want of a better phrase.

I live in Dublin, Ireland and am a very keen deep sky observer. My main scope is a TeleVue TV101, a 4-inch apochromatic refractor, on a Gibraltar alt-az mount with Digital Setting Circles.

The aperture of the TV101 is small for deep sky; however, I have had a 10-inch Dobsonian in the past and found that I didn't use it on account of it's weight and bulkiness. I have reviewed this telescope before and don't intend to repeat it here, suffice it to say that with astronomical equipment, I like it to be portable, very easy to use, hence the computerised alt-az mount and very quick set up time.

Ireland is not blessed with a good climate and I found that I was not getting as much observing done as I would like. This is what triggered my original interest in Solar observing. It struck me that if I developed an interest in Solar work that I would double the amount

of potential observing available to me. In fact, a bit of consideration reveals that I would **more** than double the amount of observing available. Before observing, I look out the window periodically over the evening and if by bedtime the sky hasn't cleared I go to bed. As soon as I go to bed, I lose out on any observing opportunities that may present themselves if the sky clears overnight.

This is not the case with Solar observing. With Solar observing, you are awake all day so in principle you can take advantage of any sky clearance. Other advantages of developing an interest in the Sun include the fact that the Sun is actually the majority of the observable Solar System, it's surface occupying more of the sky than all the planets put together. You don't need a large or expensive telescope in order to observe in H-alpha and in addition, the Sun is completely unaffected by light pollution, in fact it is the cause of most daytime 'light pollution'!

I have tried white light observing in the past and it just did not interest me. Prominence filters, such as those made by Lumicon or Thousand Oaks, which have a wide bandwidth, are considerably cheaper than the true narrowband H-alpha systems. However, narrow-

band systems, such as those manufactured by DayStar or Coronado, reveal the fascinating disk detail in the chromosphere, which I definitely wanted to see.

After considering both company's offerings, I went with Coronado in the end because I wanted a 'no fuss' system and didn't want the hassle of having to configure my optics carefully in order to get the system to work. The wisdom of doing this was borne out when I read the half page 'instruction manual' I got with my system, which basically said put one element on the front, another on the back and look!! Just what I wanted.

Originally, I intended going for the 40mm version, but after corresponding with several kind individuals online and chatting to the people at Coronado, I was talked into going for the SolarMax 90. Like many of you reading this who have bought equipment in the past, I **wanted** to be talked into buying the bigger one, but had to justify the increased expenditure to myself.....a well worn path!!!

Although Coronado do make a larger 140mm version, my understanding is that you would only get the benefit of the extra aperture for a few days a year, due to atmospheric turbulence. You are also looking at **serious** money for the larger version.

I felt that if I went for a smaller filter than the SolarMax 90, I would constantly wonder what the view through the larger aperture was like. If I went larger, I would constantly wonder what the impact of a bread and water diet for an extended period on my life expectancy would be!!

When I called Coronado and ordered the SolarMax 90 I was told that there was a 3 month waiting list and was given an expected delivery date. The filter arrived on



The SolarMax 90 Etalon

time as promised. I have to say that all the people at Coronado I spoke to offered an exceptionally good service. They were always willing to answer my questions, either by email or on the phone and were unfailingly helpful and polite. Even now, long after my purchase, I have had occasion to call them for various reasons and they remain a pleasure to deal with. I mention this because, in my experience, you rarely read of good purchasing experiences online since those who have a hassle-free buy rarely feel obliged to tell others.

Out of the box

The instrument was exceptionally well packaged for transit. It arrived in a sturdy cardboard box. Inside the box was a plastic case suspended within the outer box

in a foam construction for protection. Nestling inside the foam filled plastic case was the front element, consisting of the Fabry Perot etalon plus Energy Rejection Filter, and the BF10 blocking filter encased inside a custom made 1.25 inch star diagonal.

The front element is very well built, with an almost 'overbuilt' quality reminiscent of an Astrophysics or TelVue refractor. It is satisfyingly heavy and comes complete with two thick metal dust caps which screw in both sides of the solid metal cell. Coronado also include a tilting mechanism on the front element, allowing you to detune the filter slightly off the H-alpha bandpass to view Doppler shifted features. This consists of a wheel on the front element which tilts the element slightly. The front element is gold coated, presumably to reflect heat and prevent the element from getting too hot.

The BF10 blocking filter comes within a star diagonal and again is gold coated. In order to use the system you pop the BF10 into the back of your scope and attach the Front element in front of the objective. In my case, it screws directly into the lens cell of my TV101 although I am in the process of getting a Takahashi Sky 90 for it, which requires a simple adapter, available from Coronado, to mate the front element to the telescope.

First light

First light was from my back garden, on Dublin's south coast. I screwed the front element into my TV101, popped the BF10 into the focuser, added a low power 20mm Plossl giving 27X and looked at the Sun.

Everyone in this hobby remembers their first views, probably through a shaky 60mm refractor of the night sky. The visual impact of those images of Saturn's rings or the first quarter Moon are only rarely equalled afterwards. My first view through my SolarMax 90 was one

of those moments. A world I never knew existed was suddenly revealed to me in glorious detail. I actually started laughing out loud I was so excited.

The first thing you notice is the vivid orange-red colour. The H-alpha light has a quality that is absent from everyday experience, presumably because the narrow bandwidth generates light with a purity of colour unmatched in Nature. The Sun looks like it has been painted with a laser. At low powers the sun has a 3D quality I have never seen elsewhere, even on the Moon. The overall impression, particularly at low power, is that the Sun is transformed from a harmless outdoor light into a seething 'Death Star'. You really do get an appreciation of the fact that what you are witnessing is a contained thermonuclear explosion.

All around the solar limb is what looks like orange 'grass'. Superimposed on this are prominences with an incredible level of detail. Big ones, small ones and all showing fascinating changes as you watch for an hour or two.

Then, there is the chromosphere. The disc has an incredible level of detail on it, particularly around sunspots. Bright areas or plages are obvious. In addition, the Sun appears as if it had split in several areas as dark filaments crossed the disk. The whole disk is covered in a dense intricate network of very fine dark lines.

The SolarMax 90 allowed plenty of light through, and a beautiful image was obtained at 135X giving a nice balance of detail and brightness. Although a very low magnification does give a striking 3D quality to the image, you do lose some detail and the image can be a bit too bright. I tried 180X but the sky was a bit turbulent at mid-morning and the view was more satisfying

at lower powers. However, I will try 180X again at some time nearer sunrise, since I felt that there was plenty of light at this magnification and I was merely being limited by atmospheric turbulence, which is lower soon after sunrise, before the air heats up.

Detuning the filter using the tilting mechanism allows you to view Doppler shifted events. These are flares that are moving so rapidly that their wavelength is effectively compressed or shifted to a higher frequency. Since the H-alpha filter has a very narrow bandpass, the light from these events can be shifted right out of the bandpass, rendering them invisible.

Tilting the front element detunes the filter allowing you to see these features. Although this tilting mechanism was optional in the past, they are now an integral part of the package. To my mind, this is a big advantage, as they offer the ability to see features that were otherwise invisible. In addition, they allow various features to be made more prominent, depending on the tilt. At one position, you see the prominences mainly, while at another, the chromospheric network is more obvious while the prominences are somewhat less visible.

As I watched a plane flew across the H-alpha disk. As it crossed the flaming limb, racked by prominences, the exhaust caused the solar limb to shimmer momentarily. I wished I had a camera to capture the almost uniquely 21st century moment, a stunningly beautiful conjunction of two pieces of advanced technology which I felt truly privileged to witness.

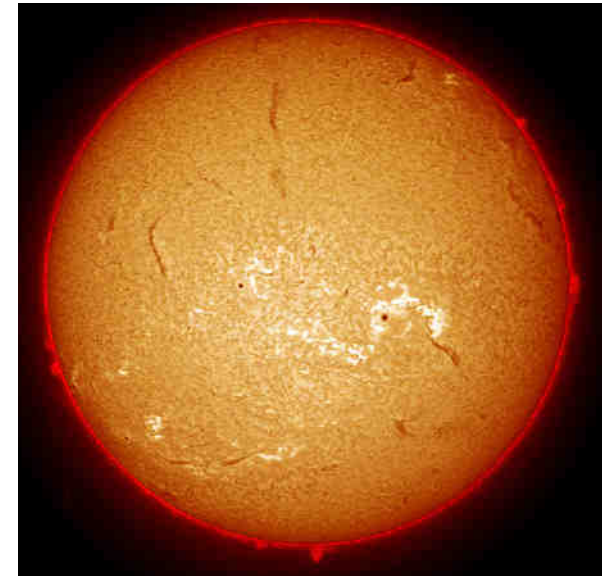
Summary

I highly recommend this system, The views have actually exceeded my expectations. As I explained, I bought this system to increase the amount of observing I do, and it has definitely done this. My frustration

with the vagaries of the Irish weather has diminished considerably, no mean feat!! Before I got the filter, I thought that Solar observing would be a nice diversion, but that it would always remain 'second best' when compared to the pleasures of viewing the night sky. I have to say that I have completely revised this opinion. The views through this system are nothing short of incredible. Viewing the Sun in H-alpha is now right up there with the deep sky in terms of sheer observing pleasure. This system has totally re-energised my interest in observing, opening up a whole new and exciting area of interest to me.

As I mentioned earlier, I could spend \$10,000 on a new scope tomorrow and I'd still have to wait for a clear night to use it. In addition, many people travel half way round the globe to view prominences for a couple of minutes during a total eclipse. With a H-alpha system, you can view these features every day, for a fraction of the cost of a couple of trips chasing totality. Although the system is expensive, you have to compare like with like. Reading the technical details on <http://www.coronadofilters.com> I would imagine that fabricating one of these filters requires a similar, if not greater, level of effort than making an apochromatic refractor, which many people will wait several years for and pay a lot of money. It is almost certain that worsening light pollution will make solar observing one of the big growth areas in amateur astronomy over the next few decades. Therefore, the cost of H-alpha systems will only go up as more people realise the fun to be had in this area of astronomy. In addition, I can see waiting lists for these systems growing.

My only regret is that I have so long to go before the next Solar Maximum, I should have bought it years ago. Don't make the same mistake. Buy one while you can.



The Sun in H-Alpha, Jan. 4, 2002.

Resources

Current Ha Image: <http://solar.spacew.com/sunnow/>
Solar A.L.P.O. Yahoo Group:

<http://groups.yahoo.com/group/Solar-ALPO/?yguid=146132119>

A.L.P.O. Solar Section:

<http://www.lpl.arizona.edu/~rhill/alpo/solar.html>

Space Weather: <http://www.spaceweather.com/>

Coronado Filters Solar Chat:

<http://www.coronadofilters.com/ikon/cgi-bin/ikonboard.cgi>

Solar Photography: <http://www.astro-nut.com/sun.html>

Observing the Sun in Hydrogen-Alpha Light:

<http://mysite.verizon.net/gpiepol/megrez80.html>

Close-Up of a Star (Sky & Telescope article):

<http://skyandtelescope.com/observing/objects/sun/>

RedShift 4 Review

By Gary Nugent

Installation

RedShift 4 comes on two CD-ROMs and offers you three types of install depending on how you want to use the program and how much free hard disk space you have. These range from a minimum of 80Mb up to 420Mb with a recommended install of 260Mb. The more data you install on your hard disk the less will be required from the CD-ROM's with the maximum install only requiring the second CD to view the lectures.

To run RedShift you need at least a Pentium processor running at 200 MHz with 64 megabytes of RAM, 2 megabytes of video RAM, 80 megabytes of hard disk space, an 800 x 600 (16-bit) display and a 4x CD-ROM drive.

Installation was very easy on all four platforms that I tested this program on: Windows 98, Windows NT4, Windows 2000 and Windows XP. The simple installation instructions provided will soon have you up and running.

Once installation is completed, an animated and narrated introduction shows you how to get started and displays some of the features of the application. Your first task is to set the latitude and longitude from where you want to view the sky - this will normally be your home location.

RedShift 4 uses many catalogues for its data base of stars and objects including the Tycho-2, Hipparcos, Hubble Space Telescope Guide Star Catalogues, and the General Catalogue of Variable Stars. This allows over 18 million stars to be plotted down to magnitude 20. It also uses the PGC (Principal Galaxies Catalogue) containing 73,197 galaxies and has a complete model of the solar system. You can simulate the sky from any planet in our system, not just Earth, or fly through the system like an interplanetary probe. The planetary positions are calculated by the Bureau des Longitudes method VSOP87. Over 2000 years into the past or future, the positions are claimed to be correct to better than 0.1 arcsec. For the inner planets this is better than 0.01 arcsec for 4000 years into the past or future. Since Pluto is not included in VSOP87, a Keplerian orbit is used which is based on an alternative model that covers 1885 to 2099 AD. 15,000 asteroid orbits and 1,700 comets are also in the database.

Sky Diary

This is an excellent feature which displays sky events for the selected month as seen from your location. Events include lunar phases, planetary conjunctions, meteor showers, eclipses and so on. Selecting an event from the calendar produced provides more detailed information on the event. Unfortunately, there's no provision to print out the calendar of events.

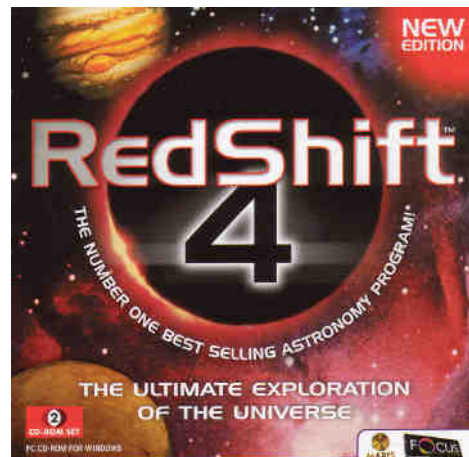
Sky Charts

Of course the program will also plot the night sky as well. There are plenty of options to change, so you

alter the way you want the chart to look to suit your own preferences. You can, of course, print your charts, which it does well. I do, however, have some criticisms of the charting part of RedShift 4. For one, you cannot save a chart to an image file. This is a serious omission and one that should be rectified in a future version or upgrade. In my capacity as an editor for a society publication, I can't use RedShift to produce the sky maps that appear on its sky diary pages. I use [SkyMap Pro](#) instead. In addition, RedShift doesn't provide a facility to plot the tracks of comets, asteroids or planets on a map over time - another serious omission. SkyMap Pro provides this facility as can be seen from the sky maps in recent issues.

Adding and removing objects from the display, however, is easy, and spacecraft can even be plotted as they track across the sky if you want to observe them. It's not wise to try to view too much at a time, though, as the star charts can scroll quite jerkily even without these extras. In fact, this is one area where RedShift 4 does let itself down a little; the jerkiness is evident even on a reasonably fast (700MHz) processor.

RedShift introduces the concept of "Workspaces". These are simply different windows that the application can have open simultaneously, each showing views of events from different locations. So, for example, you can watch an eclipse from the earth, moon and sun all at the same time. A movie recorder feature lets you create videos of your own journeys through space and time.



Other Features

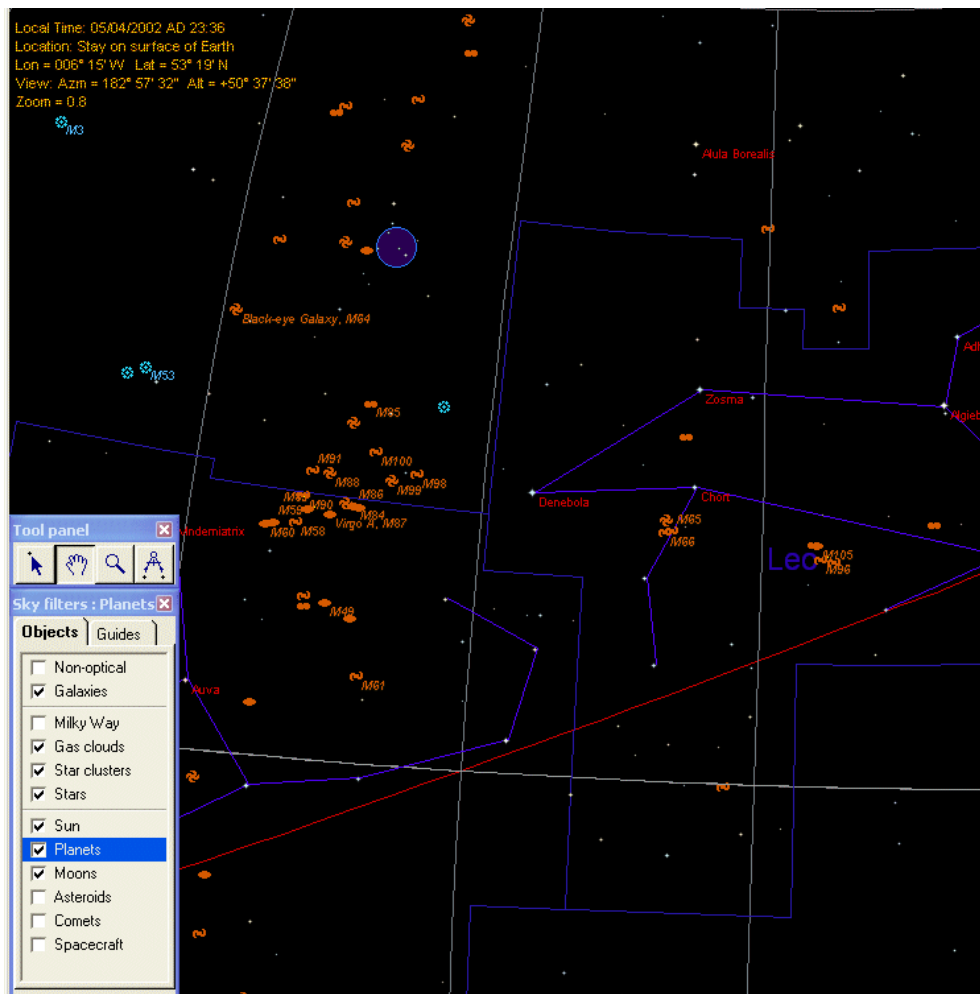
This version has Jacqueline Mitton's Dictionary of Astronomy, a Photo Gallery full of astronomical images (so you can check that you really have found the right fuzzy blob) and a database of astronomical record breakers (good browsing for a cloudy night), all of which can be presented through animated astronomy lectures that are of very good quality. The quality of the maps and images that can be produced by RedShift 4 are also excellent, especially since it contains detailed surface maps of the terrestrial planets and the Moon as well as simpler maps for the other planets and their moons.

The ten lectures themselves cover topics from the Big Bang to the history of the solar system to double stars and more.

Problems

There are bugs in the calculation of the times of the four major lunar phases. Times can be off by as much as an hour and I haven't seen a phase time that's closer than half an hour to the real time. Such inaccuracy is pretty hard to miss. Makes you wonder what other discrepancies the programmers missed before releasing this application!

I found the interface to be very clumsy and by far the



Part of a typical "workspace" in RedShift

worst of several alternative planetarium programs that I have recently used. One frustrating aspect is that

when the program is undertaking a long calculation, e.g. when the positions of a large number of asteroids are requested, no hour-glass icon is displayed and the screen freezes. This gives the distinct impression that the program has crashed.

In calculating the positions of objects, RedShift 4 claims unprecedented levels of positional accuracy, i.e. planetary positions to one tenth of an arcsecond and Hipparcos stars to one thousandth of an arcsecond. However, when positions are listed in the pop-up windows they are only given to the nearest 15 arcsec in right ascension and one arcsec in declination. While RedShift 4 boasts that it can provide orbital positions for over 1,700 comets no information is given about which are currently bright enough to be seen. In the largest telescopes only about 50 of these will be bright enough to be detected on any given date.

In order to assess the reliability of RedShift's data I contacted other users of the application. This randomly chosen sample yielded a surprisingly large number of errors. While it is well known that RR Lyrae stars have a constant absolute magnitude of about 0.5, SW And and RR Gem are listed with the absolute magnitudes of -7.10

and 5.416 respectively! Clicking on M31, the Andromeda galaxy, yielded a panel that gave the distance

as blank. Edwin Hubble would be very disappointed. The program also fails to provide direct hypertext links from objects in the planetarium section to the program's astronomy dictionary section and the search facilities for particular objects are limited.

RedShift also does not use one of the standard orbital element file formats for comets and asteroids. This means that updated elements are unavailable for existing comets and asteroids that come with the program. Only newly discovered objects are available for download. This is a serious flaw. Better applications can have the orbital elements of various objects updated simply by downloading the latest elements from websites such as the Minor Planet Center's "Orbital Elements for Software Packages" page (<http://cfa-www.harvard.edu/iau/Ephemerides/SoftwareEls.html>). Such files typically contain a list of various objects with the latest parameters defining their orbits. RedShift's approach, however, is to treat each object as a discrete file. If you want to add new comets to RedShift, for instance, you have to download a separate file for each object! Not exactly user friendly! Updating the elements at a later date is not even an option as the information is just not available. The only site where the RedShift specific orbital elements are available is their own website: <http://www.RedShift.maris.com> (you need to click on the Upgrade option on the page). To cap it all, the most recent "new" comet data available at their site is for comet C/2001 T4 (NEAT) , dated 19 Nov. 2001. Yup,

Sky Diary

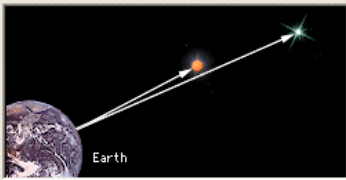
Location: Earth Lon 6°15'0"W Lat 53°19'59"N Dublin for March 2002 AD

Events Planets Eclipses Conjunctions

Date	Event
04th	gamma Librae 2.8°N of Moon
06th	Last Quarter of Moon
06th	Pluto 10.5°N of Moon
07th	Pluto at quadrature
09th	Uranus 1.2°N of Mercury
10th	Neptune 4.7°N of Moon
11th	Uranus 4.4°N of Moon
12th	Mercury 3.3°N of Moon
14th	New Moon
15th	Venus 4.9°N of Moon
18th	Mars 4.6°N of Moon
20th	Saturn 0.5°N of Moon

Found 20

The time given (on the right) is when the Moon passes to the north or south (in the celestial sphere) of the star. Although at that moment the Moon may not be visible from your present location, it is still likely that you will be able to see it very close to the star in the sky. Check RedShift's Reports for the Moon. You will be able to see this conjunction if the Moon is above the horizon on this day or the next, during darkness, or with more difficulty during twilight.



gamma Librae 2.8°N of Moon

04 March 14:54 (local time) - topocentric
Invisible from current location

In constellation Libra

gamma Librae magnitude 3.91

Moon phase 65%

Close Apply OK

The Sky Diary window in RedShift (it can't be enlarged)

that's right, data for Comet Ikeya-Zhang wasn't even available!

Conclusion

RedShift includes a link to the [RedShift Web site](#) for downloading new discoveries, upgrades, object lists and technical support so keeping the program up to date is never a problem (unless, of course, you don't have an internet connection and you don't mind certain data being unavailable).

Despite my reservations, RedShift 4 does appear to

have a loyal following and other more favourable reviews can be found elsewhere. These in general are very positive, e.g. "Amazing program - amazing price", "a real treasure trove of information and an absolute bargain". However, from the educational point of view, while RedShift 4 promises much, the inaccuracies and user-unfriendly interface are disappointing.

I've used all the different versions of RedShift from V1.0 to V4.0. Try as I might, I just don't like the "feel" of this program although the interface is somewhat better now than it was in earlier releases. It's very powerful in certain respects and has some features that I do use but I only use those features because they're not available in other applications.

At time of writing, RedShift 4 was extremely cheap - only STG£9.99 from [Amazon UK](#) (it used to sell for STG£19.99 and originally cost US\$57.95). It is not available from Amazon US, although [RedShift 3](#) still is(!).

On price alone, it's probably worth buying and its simulations and multimedia lectures are very good but questions remain about the accuracy of its calculations and data. That uncertainty makes me go to different, more reliable applications. Pity. [Redshift 5](#) has now been released. Hopefully it's a more robust product.

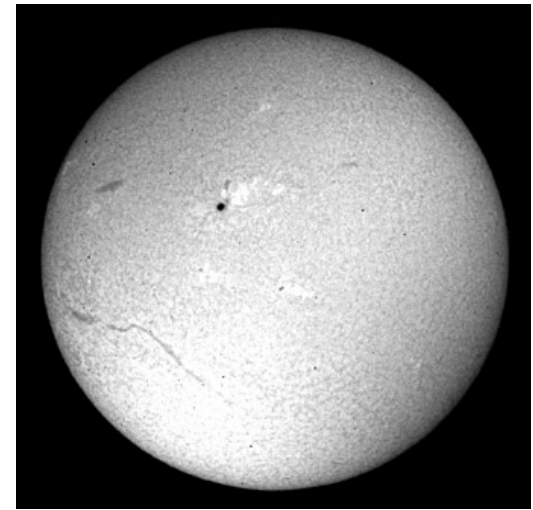
Showcase

If you have images/photos, please consider sending them in to us.

Right: The Sun in H-alpha light, taken in March 2003 through a Televue 101 refractor fitted with a Coronado H-alpha filter. The image was captured with a Toucam Pro webcam and converted to B&W to bring out the granularity and surface features. Photo: © Kevin Berwick.

Bottom Left: Auroral arc seen from Dublin, Ireland in November 2003. ISO 200 Kodacolor Gold film. The exposure was approximately 30 secs long through a 28mm lens. Photo: © Gary Nugent.

Bottom Right: M57 (Ring Nebula) in Lyra. This 10-minute stacked image (10 1-minute images) was taken through a Vixen VC200L 8" (200mm) reflector with a Starlight Xpress SXV-H9 CCD camera. The image was processed in AIP4WIN to bring out some of the subtle detail and then brightness/contrast adjusted in PhotoShop. The satellite track only appeared on one of the images. Photo: © Gary Nugent.



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